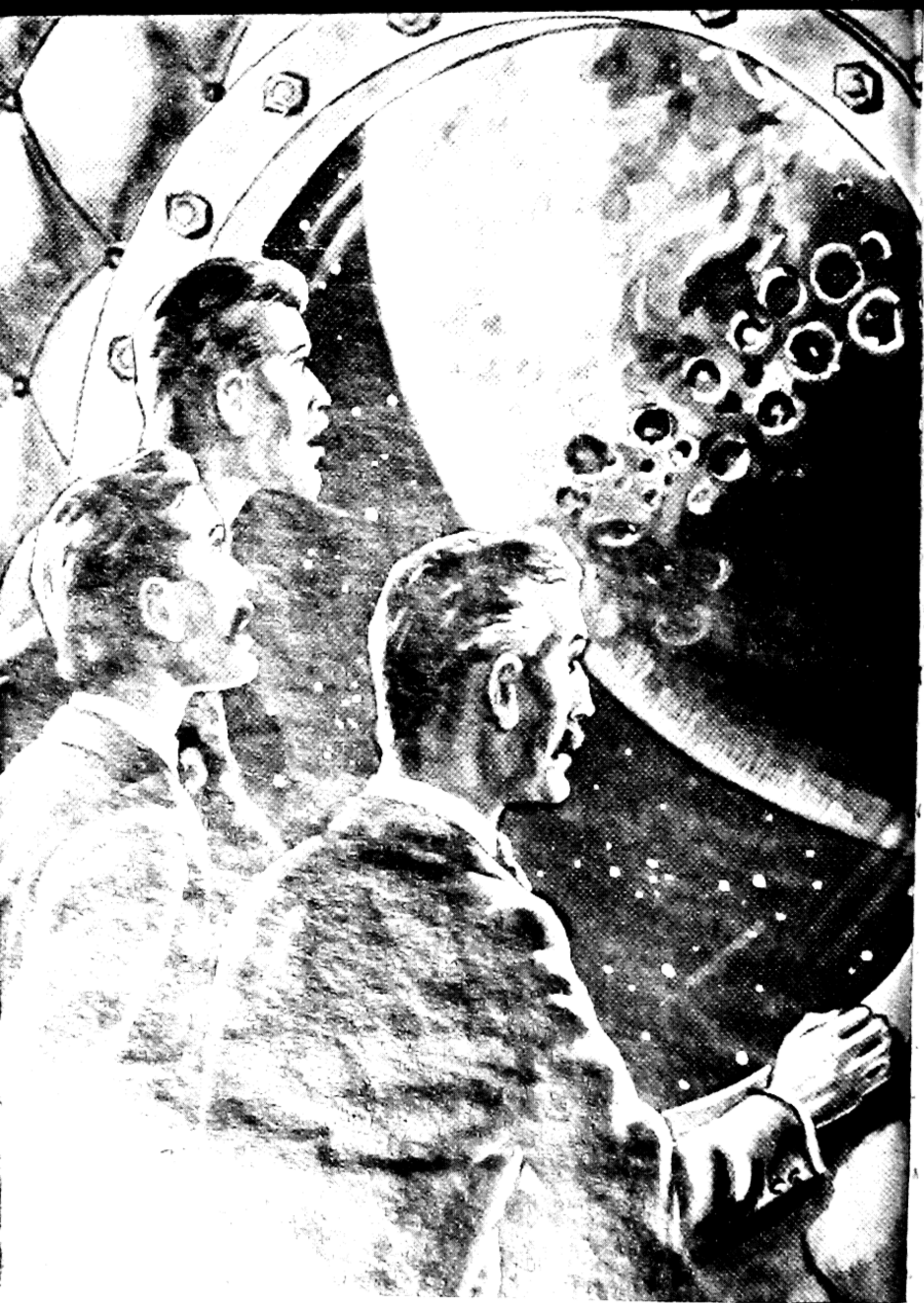


# ROUND THE MOON







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# **ROUND THE MOON**

**Jules Verne**

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## HOW IT ALL BEGAN

DURING the course of the year 186—the entire world was singularly excited by a scientific experiment without precedent in the long history of science. The members of the Gun Club, a circle of artillerymen established at Baltimore after the American Civil War, had the idea of communicating with the moon—yes, with the moon—by sending a missile to her. Their president, Barbicane, the promoter of the enterprise, having consulted the astronomers of the Cambridge Observatory on this subject, took all the precautions necessary for the success of the extraordinary enterprise, declared possible by the majority of competent people.

According to the plan drawn up by the members of the Observatory, the cannon destined to hurl the projectile was to be set up in some country situated between the  $0^{\circ}$  and  $20^{\circ}$  of north or south latitude in order to aim at the moon at the zenith. The missile was to be given an initial velocity of 12,000 yards a second. Hurlled on the 1st of December at thirteen minutes and twenty seconds to eleven in the evening, it was to get to the moon four days after its departure on the 5th of December at midnight precisely, at the very instant she would be at her perigee—that is to say, nearest to the earth, or at exactly 86,410 leagues' distance.

The principal members of the Gun Club, the president, Barbicane, Major Elphinstone, the secretary, J. T. Maston, and others, held several meetings, in which the form and composition of the missile were discussed, as well as the disposition and nature of the cannon, and the quality and quantity of the powder to be employed. It was decided—1, that the projectile should be of aluminium, with a diameter of 800 inches; its sides were to be 12 inches thick, and it was to weigh 19,250 lbs.; 2, that the cannon should be



a cast-iron Columbiad 900 feet long, and should be cast at once in the ground; 3, that the charge should consist of 400,000 lbs. of gun-cotton, which, by developing 6,000,000,000 litres of gas under the projectile, would carry it easily towards the Queen of Night.

These questions settled, President Barbicane, aided by the engineer, Murchison, chose a site in Florida in  $27^{\circ} 7'$  north lat. and  $5^{\circ} 7'$  west long. It was there that after marvels of labour the Columbiad was successfully cast.

Things were at that stage when an incident occurred which increased the interest attached to this great enterprise.

A Frenchman, a regular Parisian, an artist as witty as he was audacious, volunteered to travel in the missile in order to survey the moon. This intrepid adventurer's name was Michel Ardan. He arrived in America, was received with enthusiasm, held meetings, was carried in triumph, reconciled President Barbicane to his mortal enemy, Captain Nicholl, and in pledge of the reconciliation he persuaded them to embark with him in the projectile.

The proposition was accepted. The form of the missile was changed. It became cylindro-conical. They furnished this new design of aerial compartment with powerful springs and breakable partitions to break the departing shock. It was filled with provisions for one year, water for some months, and gas for some days. An automatic apparatus made and gave out the air necessary for the respiration of the three travellers. At the same time the Gun Club had a gigantic telescope set up on one of the highest summits of the Rocky Mountains, through which the projectile could be followed during its journey through space. Everything was then ready.

On the 1st of December, at the time fixed, amidst an extraordinary concourse of spectators, the take-off took place, and for the first time three human beings left the terrestrial globe for unknown interplanetary regions.

These audacious travellers, Michel Ardan, President Barbicane, and Captain Nicholl were to accomplish their

journey in ninety-seven hours thirteen minutes and twenty seconds; consequently they could not reach the lunar disc until the 5th of December, at midnight, at the precise moment that the moon would be full, and not on the 4th, as some wrongly-informed newspapers had given out.

But something unexpected occurred; the detonation produced by the Columbiad had the immediate effect of disturbing the earth's atmosphere, where an enormous quantity of vapour accumulated. This phenomenon excited much indignation, for the moon was hidden during several nights.

The worthy J. T. Maston, the greatest friend of the three travellers, set out for the Rocky Mountains in the company of the Honourable J. Belfast, director of the Cambridge Observatory, and reached the station of Long's Peak, where the telescope was set up which brought the moon, apparently, to within two leagues. The honourable secretary of the Gun Club wished to observe for himself the missile that contained his audacious friends.

The accumulation of clouds in the atmosphere prevented all observation during the 5th, 6th, 7th, 8th, 9th, and 10th of December. It was even thought that no observation could take place before the 3rd of January of the following year, for the moon, entering her last quarter on the 11th, would after that not show enough of her surface to allow the trace of the projectile to be followed.

But at last, to the general satisfaction, a strong tempest during the night between the 11th and 12th of December cleared the atmosphere, and the half-moon was distinctly visible on the dark background of the sky.

That same night a telegram was sent from Long's Peak Station by J. T. Maston and Belfast to the staff of the Cambridge Observatory. It announced that on the 11th of December, at 8.47 p.m., the projectile hurled by the Columbiad of Stony Hill had been observed by Messrs. Belfast and J. T. Maston, that the missile had deviated from its course through some unknown cause, and had not

reached its goal, but had gone near enough to be retained by the moon's gravitational attraction; that its rectilinear movement had been changed, and that it was describing an elliptical orbit round the moon, and had become her satellite.

The telegram added that its position had not yet been calculated—in fact, three observations, taking a star in three different positions, are necessary to determine it. Then it stated that the distance separating the projectile from the lunar surface “might be” estimated at about 2,833 leagues, or 4,500 miles.

It ended with the following alternative theories: Either the attraction of the moon would end by carrying the day, and the travellers would reach their goal; or the projectile, fixed in an immutable orbit, would gravitate around the lunar disc to the end of time.

In either of these alternatives what would be the travellers' fate? It is true they had provisions enough for some time. But even supposing that their bold enterprise were crowned with success, how would they return? Could they ever return? Would news of them ever reach the earth? These questions, debated upon by the most learned writers of the time, intensely interested and excited the public.

A remark may here be made which ought to be meditated upon by too impatient observers. When an “expert” announces a purely speculative discovery to the public he cannot act with too much care. No one is obliged to discover either a comet or a satellite, and those who make a mistake in such a case expose themselves justly to public ridicule. Therefore it is better to wait; and that is what impatient J. T. Maston ought to have done before sending the telegram which, according to him, contained the last communication about this enterprise.

In fact, the telegram contained errors of two sorts, verified later:—1. Errors of observation concerning the distance of the projectile from the surface of the moon, for upon the date of the 11th of December it was impossible to per-

ceive it, and that which J. T. Maston had seen, or thought he saw, could not be the missile from the Columbiad. 2. A theoretic error as to the fate of the said missile, for making it a satellite of the moon was an absolute contradiction of the laws of rational mechanics.

One hypothesis only made by the astronomers of Long's Peak might be realized, the one that foresaw the case when the travellers—if any yet existed—should employ the moon's attraction to reach its surface.

Now these men, as intelligent as they were bold, had survived the terrible shock of take-off, and their journey will be related in its most dramatic as well as in its most scientific details. This account will put an end to many illusions, but it will give a just idea of what happens during such an enterprise, and will set in relief Barbicane's scientific instincts, Nicholl's industrial resources, and the humorous audacity of Michel Ardan.

Besides, it will prove that their worthy friend J. T. Maston was losing his time when, bending over the gigantic telescope, he watched the course of the moon across the planetary regions.



## CHAPTER I

FROM 10.20 P.M. TO 10.47 P.M.

WHEN ten o'clock struck, Michel Ardan, Barbicane, and Nicholl said good-bye to the numerous friends they were soon to leave. The two dogs, destined to acclimatize this species to conditions on the moon, were already in the projectile. The three travellers approached the orifice of the enormous iron tube, and a crane lowered them to the conical covering of the missile.

There an opening let them down into the aluminium vehicle. The crane's tackle was drawn up outside, and the mouth of the Columbiad instantly cleared of its last scaffolding.

As soon as Nicholl and his companions were in the projectile he closed the opening by means of a strong plate screwed down from inside. Other closely-fitting plates covered the lenticular glasses of the skylights. The travellers, hermetically enclosed in their metal prison, were in profound darkness.

"And now, my dear companions," said Michel Ardan, "let us make ourselves at home. I am a domestic man myself, and know how to make the best of any lodgings. First let us have a light; gas was not invented for moles!"

Saying which the light-hearted fellow struck a match on the sole of his boot and then applied it to the burner of the receptacle, in which there was enough carbonized hydrogen, stored under strong pressure, for lighting and heating the compartment for 144 hours, or six days and six nights.

Once the gas lighted, the projectile presented the aspect of a comfortable room with padded walls, furnished with circular divans, the roof of which was in the shape of a dome.

The objects in it, weapons, instruments, and tools, were securely fastened to the sides in order to withstand the parting shock. Every possible precaution had been taken to ensure the success of so bold an experiment.

Michel Ardan examined everything, and declared himself quite satisfied with his quarters.

"It is a prison," said he, "but a travelling prison, and if I had the right to put my nose to the window I would take it on a hundred years' lease! You are smiling, Barbicane. You are thinking of something you do not communicate. Do you say to yourself that this prison may be our coffin? Our coffin let it be; I would not change it for Mahomet's, which only hangs in space, and does not move!"

Whilst Michel Ardan was talking thus, Barbicane and Nicholl were making their final preparations.

It was 10.20 p.m. by Nicholl's chronometer when the three travellers were definitely sealed up in their projectile. This chronometer was regulated to the tenth of a second by that of the engineer, Murchison. Barbicane looked at it.

"My friends," said he, "it is twenty minutes past ten; at thirteen minutes to eleven Murchison will fire the Columbiad; at that minute precisely we shall leave our planet. We have, therefore, still twenty-seven minutes to remain upon earth."

"Twenty-six minutes and thirteen seconds," answered the methodical Nicholl.

"Very well!" cried Michel Ardan good-humouredly; "in twenty-six minutes lots of things can be done. We can discuss grave moral or political questions, and even solve them. Twenty-six minutes well employed are worth more than twenty-six years of doing nothing. A few seconds of a Pascal or a Newton are more precious than the whole existence of a crowd of imbeciles."

"And what do you conclude from that, talker eternal?" asked President Barbicane.

"I conclude that we have twenty-six minutes," answered Ardan.

"Twenty-four only," said Nicholl.

"Twenty-four, then, if you like, brave captain," answered Ardan; "twenty-four minutes, during which we might investigate——"

"Michel," said Barbicane, "during our journey we shall have plenty of time to investigate the deepest questions. Now we must think of starting."

"Are we not ready?"

"Certainly. But there are still some precautions to be taken to deaden the first shock as much as possible!"

"Have we not water-cushions placed between movable partitions elastic enough to protect us sufficiently?"

"I hope so, Michel," answered Barbicane gently; "but I am not quite sure!"

"Ah, the joker!" exclaimed Michel Ardan. "He hopes! He is not quite sure! And he waits till we are encased to make this deplorable acknowledgment! I ask to get out."

"By what means?" asked Barbicane.

"Well!" said Michel Ardan, "it would be difficult. We are in the train, and the guard's whistle will be heard in twenty-four minutes."

"Twenty!" ejaculated Nicholl.

The three travellers looked at one another for a few seconds. Then they examined all the objects imprisoned with them.

"Everything is in its place," said Barbicane. "The question now is where we can place ourselves so as best to support the departing shock. The position we assume must be important too—we must prevent the blood rushing too violently to our heads."

"That is true," said Nicholl.

"Then," answered Michel Ardan, always ready to suit the action to the word, "we will stand on our heads like the clowns at the circus."

"No," said Barbicane; "but let us lie on our sides; we shall thus resist the shock better. When the projectile starts it will not much matter whether we are inside or in front."

"If it comes to 'not much matter' I am more reassured," answered Michel Ardan.

"Do you approve of my idea, Nicholl?" asked Barbicane.

"Entirely," answered the captain. "Still thirteen minutes and a-half."

"Nicholl is not a man," exclaimed Michel; "he is a chronometer marking the seconds, and with eight holes in——"

But his companions were no longer listening to him, but were making their last preparations with all the coolness imaginable. They looked like two methodical travellers taking their places in the train and making themselves as comfortable as possible. One wonders, indeed, of what materials these American hearts are made, to which the approach of the most frightful danger does not add a single pulsation.

Three beds, thick and solidly made, had been placed in the projectile. Nicholl and Barbicane placed them in the centre of the disc that formed the movable flooring. There the three travellers were to lie down a few minutes before their departure.

In the meantime Ardan, who could not remain quiet, turned round his narrow prison like a wild animal in a cage, talking to his friends and his dogs, Diana and Satellite, to whom it will be noticed he had some time before given these significant names.

"Up, Diana! up, Satellite!" he cried, exciting them. "You are going to show to the Selenite dogs how well-behaved the dogs of the earth can be! That will do honour to the canine race. If we ever come back here I will bring back a cross-breed of 'moon-dogs' that will become all the rage."

"If there are any dogs in the moon," said Barbicane.

"There are some," affirmed Michel Ardan, "the same as there are horses, cows, asses, and hens. I wager anything we shall find some hens."

"I bet a hundred dollars we find none," said Nicholl.

"Done, captain," answered Ardan, shaking hands with



Nicholl. "But, by the by, you have lost three bets with the president, for the funds necessary for the enterprise were provided, the casting succeeded, and lastly, the Columbiad was loaded without accident—that makes six thousand dollars."

"Yes," answered Nicholl. "Twenty-three minutes and six seconds to eleven."

"I hear, captain. Well, before another quarter of an hour is over you will have to make over another nine thousand dollars to the president, four thousand because the Columbiad will not burst, and five thousand because the projectile will rise higher than six miles into the air."

"I have the dollars," answered Nicholl, striking his coat pocket, "and I only want to pay."

"Come, Nicholl, I see you are a man of order, what I never could be; but allow me to tell you that your series of bets cannot be very advantageous to you."

"Why?" asked Barbicane.

"Because if you win the first the Columbiad will have burst, and the projectile with it, and Barbicane will not be there to pay you your dollars."

"My wager is deposited in the Baltimore Bank," answered Barbicane simply; "and in default of Nicholl it will go to his heirs."

"What practical men you are!" cried Michel Ardan. "I admire you as much as I do not understand you."

"Eighteen minutes to eleven," said Nicholl.

"Only five minutes more," answered Barbicane.

"Yes, five short minutes!" replied Michel Ardan. "And we are shut up at the bottom of a cannon 900 feet long! where there are 400,000 lbs. of gun-cotton, worth more than 1,600,000 lbs. of ordinary powder! And friend Murchison, with his chronometer in hand and his eye fixed on the hand and his finger on the electric knob, is counting the seconds to hurl us into the planetary regions."

"Enough, Michel, enough!" said Barbicane in a grave tone. "Let us prepare ourselves. A few seconds only

separate us from a supreme moment. Your hands, my friends."

"Yes," cried Michel Ardan, more moved than he wished to appear.

The three bold companions shook hands.

"God help us!" said the religious president.

Michel Ardan and Nicholl lay down on their beds in the centre of the floor.

"Thirteen minutes to eleven," murmured the captain.

Twenty seconds more! Barbicane rapidly put out the gas, and lay down beside his companions.

The profound silence was only broken by the chronometer beating out the seconds.

Suddenly a frightful shock was felt, and the projectile, under the impulsion of 6,000,000,000 litres of gas developed by the deflagration of the pyroxyle, rose into space.

## CHAPTER II

### THE FIRST HALF-HOUR

WHAT had happened? What was the effect of the frightful shock? Had the ingenuity of the constructors of the projectile been attended by a happy result? Was the effect of the shock deadened, thanks to the springs, the four buffers, the water-cushions, and the movable partitions? Had they triumphed over the frightful impulsion of the initial velocity of 11,000 metres a second? This was evidently the question the thousands of witnesses of the exciting scene asked themselves. They forgot the object of the journey, and only thought of the travellers! Suppose one of them—J. T. Maston, for instance—had been able to get a glimpse of the interior of the projectile, what would he have seen?

Nothing then. The obscurity was profound in the compartment. Its cylindro-conical sides had resisted perfectly. There was not a break, a crack, or a dent in them. The admirable projectile was not hurt by the intense deflagration of the powders, instead of being liquefied, as it was feared, into a mass of aluminium.

In the interior there was very little disorder on the whole. A few objects had been violently hurled up to the roof, but the most important did not seem to have suffered from the shock. Their fastenings were intact.

On the movable disc, crushed down to the bottom by the smashing of the partitions and the escape of the water, three bodies lay motionless. Did Barbicane, Nicholl, and Michel Ardan still breathe? Was the projectile nothing but a metal coffin carrying three corpses into space?

A few minutes after departure one of the bodies moved, stretched out its arms, lifted up its head, and succeeded in

getting upon its knees. It was Michel Ardan. He felt himself, uttered a sonorous "Hum," then said—

"Michel Ardan, complete. Now for the others!"

The courageous Frenchman wanted to get up, but he could not stand. His head vacillated; his blood, violently sent up to his head, blinded him. He felt like a drunken man.

"Brrr!" said he. "I feel as though I had been drinking two bottles of Corton, only that was not so agreeable to swallow!"

Then passing his hand across his forehead several times, and rubbing his temples, he called out in a firm voice—

"Nicholl! Barbicane!"

He waited anxiously. No answer. Not even a sigh to indicate that the hearts of his companions still beat. He reiterated his call. Same silence.

"The devil!" said he. "They seem as though they had fallen from the fifth storey upon their heads! Bah!" he added with the imperturbable confidence that nothing could shake, "If a Frenchman can get upon his knees, two Americans will have no difficulty in getting upon their feet. But, first of all, let us have a light on the subject."

Ardan felt life come back to him in streams. His blood became calm, and resumed its ordinary circulation. Fresh efforts restored his equilibrium. He succeeded in getting up, took a match out of his pocket, and struck it; then putting it to the burner he lighted the gas. The meter was not in the least damaged. The gas had not escaped. Besides, the smell would have betrayed it, and had this been the case, Michel Ardan could not with impunity have lighted a match. The gas, mixed in the air, would have produced a detonating mixture, and an explosion would have finished what a shock had perhaps begun.

As soon as the gas was lighted Ardan bent down over his two companions. Their bodies were thrown one upon the other, Nicholl on the top, Barbicane underneath.

Ardan raised the captain, propped him up against a divan, and rubbed him vigorously. This friction, adminis-



tered skilfully, reanimated Nicholl, who opened his eyes, instantly recovered his presence of mind, seized Ardan's hand, and then looking round him——

"And Barbicane?" he asked.

"Each in turn," answered Michel Ardan tranquilly. "I began with you, Nicholl, because you were on the top. Now I'll go to Barbicane."

That said, Ardan and Nicholl raised the president of the Gun Club and put him on a divan. Barbicane seemed to have suffered more than his companions. He was bleeding, but Nicholl was glad to find that the hæmorrhage only came from a slight wound in his shoulder. It was a simple scratch, which he carefully closed.

Nevertheless, Barbicane was some time before he came to himself, which frightened his two friends.

"He is breathing, however," said Nicholl, putting his ear to the breast of the wounded man.

"Yes," answered Ardan, "he is breathing like a man who is in the habit of doing it daily. Rub, Nicholl, rub with all your might."

And the two improvised practitioners set to work with such a will and managed so well that Barbicane at last came to his senses. He opened his eyes, sat up, took the hands of his two friends, and his first words were——

"Nicholl, are we going on?"

Nicholl and Ardan looked at one another. They had not yet thought about the projectile. Their first anxiety had been for the travellers, not for the vehicle.

"Well, really, are we going on?" repeated Michel Ardan.

"Or are we tranquilly resting on the soil of Florida?" asked Nicholl.

"Or at the bottom of the Gulf of Mexico?" added Michel Ardan.

"Impossible!" cried President Barbicane.

These two suggestions, made by his two friends immediately recalled him to life and energy.

They could not yet decide the question. The apparent

immovability of the craft and the want of communication with the exterior prevented them finding it out. Perhaps the projectile was falling through space. Perhaps after rising a short distance it had fallen upon the earth, or even into the Gulf of Mexico, a fall which the narrowness of the Floridian peninsula made possible.

The case was serious, the problem interesting. It was necessary to solve it as soon as possible. Barbicane, excited, and by his moral energy triumphing over his physical weakness, stood up and listened. A profound silence reigned outside. But the thick padding was sufficient to shut out all the noises on earth. However, one thing struck Barbicane. The temperature in the interior of the projectile was singularly high. The president drew out a thermometer from the envelope. The instrument showed  $81^{\circ}$  Fahr.

"Yes!" he then exclaimed—"yes, we are moving! This stifling heat oozes through the sides of our projectile. It is produced by friction against the atmosphere. It will soon diminish; because we are already moving in space, and after being almost suffocated we shall endure intense cold."

"What!" asked Michel Ardan, "do you mean to say that we are already beyond the terrestrial atmosphere?"

"Without the slightest doubt, Michel. Listen to me. It now wants but five minutes to eleven. It is already eight minutes since we started. Now, if our initial velocity has not been diminished by friction, six seconds would be enough for us to pass the sixteen leagues of atmosphere which surround earth."

"Just so," answered Nicholl; "but in what proportion do you reckon the decrease of speed by friction?"

"In the proportion of one-third," answered Barbicane. "This decrease is considerable, but it is so much according to my calculations. If, therefore, we have had an initial velocity of 11,000 metres, when we get past the atmosphere it will be reduced to 7,332 metres. However that may be, we have already cleared that space, and——"

"And then," said Michel Ardan, "friend Nicholl has lost

his two bets—four thousand dollars because the Columbiad has not burst, five thousand dollars because the projectile has risen to a greater height than six miles; therefore, Nicholl, shell out.”

“We must prove it first,” answered the captain, “and pay afterwards. It is quite possible that Barbicane’s calculations are exact, and that I have lost my nine thousand dollars. But another idea has come into my mind, and it may cancel the wager.”

“What is it?” asked Barbicane quickly.

“The idea that for some reason or other the powder did not fire, and we have not started.”

“Good heavens! captain,” cried Michel Ardan, “that is a supposition worthy of me! It is not serious! Have we not been half stunned by the shock? Did I not bring you back to life? Does not the president’s shoulder still bleed from the blow?”

“Agreed, Michel,” replied Nicholl, “but allow me to ask one question.”

“Ask it, captain.”

“Did you hear the detonation, which must certainly have been formidable?”

“No,” answered Ardan, much surprised, “I certainly did not hear it.”

“And you, Barbicane?”

“I did not either.”

“What do you make of that?” asked Nicholl.

“What indeed!” murmured the president; “why did we not hear the detonation?”

The three friends looked at one another rather disconcertedly. Here was an inexplicable phenomenon. The projectile had been fired, however, and there must have been a detonation.

“We must know first where we are,” said Barbicane, “so let us open the panel.”

This operation was immediately accomplished. The screws that fastened the bolts on the outer plates of the



right-hand skylight yielded to the coach-wrench. These bolts were driven outside, and obturators wadded with rubber corked up the hole that let them through. The exterior plate immediately fell back upon its hinges like a port-hole, and the lenticular glass that covered the hole appeared. An identical light-port had been made in the other side of the projectile, another in the dome, and a fourth in the bottom. The firmament could therefore be observed in four opposite directions—the firmament through the lateral windows, and the earth or the moon more directly through the upper or lower opening of the projectile.

Barbicane and his companions immediately rushed to the uncovered port-hole. No ray of light illuminated it. Profound darkness surrounded the projectile. This darkness did not prevent Barbicane exclaiming—

“No, my friends, we have not fallen on the earth again! No, we are not immersed at the bottom of the Gulf of Mexico! Yes, we are going up through space! Look at those stars that are shining in the darkness, and the impenetrable darkness that lies between the earth and us!”

“Hurrah! hurrah!” cried Michel Ardan and Nicholl with one voice.

In fact, the thick darkness proved that the projectile had left the earth, for the ground, then brilliantly lighted by the moon, would have appeared before the eyes of the travellers if they had been resting upon it. This darkness proved also that the projectile had passed beyond the atmosphere, for the diffused light in the air would have been reflected on the metallic sides of the projectile, which reflection was also wanting. This light would have shone upon the glass of the light-port, and that glass was in darkness. Doubt was no longer possible. The travellers had quitted the earth.

“I have lost,” said Nicholl.

“I congratulate you upon it,” answered Ardan.

“Here are nine thousand dollars,” said the captain, taking a bundle of notes out of his pocket.

"Will you have a receipt?" asked Barbicane as he took the money.

"If you do not mind," answered Nicholl; "it is more regular."

And as seriously and phlegmatically as if he had been in his counting-house, President Barbicane drew out his memorandum-book and tore out a clear page, wrote a receipt in pencil, dated it, signed it, and gave it to the captain, who put it carefully into his pocket-book.

Michel Ardan took off his hat and bowed to his two companions without speaking a word. Such formality under such circumstances took away his power of speech. He had never seen anything so American.

Once their business over, Barbicane and Nicholl went back to the light-port and looked at the constellations. The stars stood out clearly upon the dark background of the sky. But from this side the moon could not be seen, as she moves from east to west, rising gradually to the zenith. Her absence made Ardan say—

"And the moon? Is she going to fail us?"

"Do not frighten yourself," answered Barbicane. "She is at her post, but we cannot see her from this side. We must open the opposite light-port."

At the very moment when Barbicane was going to abandon one window to set clear the opposite one, his attention was attracted by the approach of a shining object. It was an enormous disc the colossal dimensions of which could not be estimated. Its face turned towards the earth was brilliantly lighted. It looked like a small moon reflecting the light of the large one. It advanced at prodigious speed, and seemed to describe round the earth an orbit right across the passage of the projectile. To the movement of translation of this object was added a movement of rotation upon itself. It was therefore behaving like all celestial bodies in space.

"Eh!" cried Michel Ardan. "Whatever is that? Another projectile?"



It was an enormous disc of colossal dimensions



Barbicané did not answer. The sight of this enormous body surprised him and made him uneasy. A collision was possible which would have had deplorable results, either by making the projectile deviate from its route and fall back upon the earth, or be caught up by the attractive power of the asteroid.

President Barbicané had rapidly seized the consequences of this, which in one way or other would fatally prevent the success of their attempt. His companions were silently watching the object, which grew prodigiously larger as it approached, and through a certain optical illusion it seemed as if the projectile were rushing upon it.

"Ye gods!" cried Michel Ardan; "there will be a collision on the line!"

The three travellers instinctively drew back. Their terror was extreme, but it did not last long, hardly a few seconds. The asteroid passed at a distance of a few hundred yards from the projectile and disappeared, not so much on account of the rapidity of its course, but because its side opposite to the moon was suddenly confounded with the absolute darkness of space.

"A good journey to you!" cried Michel Ardan, uttering a sigh of satisfaction. "Is not infinitude large enough to allow a poor little projectile to go about without fear? What was that pretentious globe which nearly knocked against us?"

"I know!" answered Barbicané.

"Of course! you know everything."

"It is a simple asteroid," said Barbicané; "but so large that the attraction of the earth has kept it in the state of a satellite."

"Is it possible!" exclaimed Michel Ardan. "Then the earth has two moons like Neptune?"

"Yes, my friend, two moons, though she is generally supposed to have but one. But this second moon is so small and her speed so great that the inhabitants of the earth cannot perceive her. It was by taking into account certain perturbations that a French astronomer, M. Petit, was able to

determine the existence of this second satellite and calculate its orbit. According to his observations, this asteroid accomplishes its revolution round the earth in three hours and twenty minutes only. That implies prodigious speed."

"Do all astronomers admit the existence of this satellite?" asked Nicholl.

"No," answered Barbicane; "but if they had met it like we have they could not doubt any longer. By the by, this asteroid, which would have much embarrassed us had it knocked against us, allows us to determine our position in space."

"How?" said Ardan.

"Because its distance is known, and where we met it we were exactly at 8,140 kilometres from the surface of the terrestrial globe."

"More than 2,000 leagues!" cried Michel Ardan. "That beats the express trains of the pitiable globe called the earth!"

"I should think it did," answered Nicholl, consulting his chronometer; "it is eleven o'clock, only thirteen minutes since we left the American continent."

"Only thirteen minutes?" said Barbicane.

"That is all," answered Nicholl; "and if our initial velocity were constant we should make nearly 10,000 leagues an hour."

"That is all very well, my friends," said the president; "but one question still remains—why did we not hear the detonation of the Columbiad?"

For want of an answer the conversation stopped, and Barbicane, still reflecting, occupied himself with lowering the covering of the second lateral light-port. His operation succeeded, and through the glass the moon filled the interior of the projectile with brilliant light. Nicholl, like an economical man, put out the gas that was thus rendered useless, and the brilliance of which obstructed the observation of planetary space.

The lunar disc then shone with incomparable purity.



Her rays, no longer filtered by the vapoury atmosphere of earth, shone clearly through the glass and saturated the interior air of the projectile with silvery reflections. The black curtain of the firmament really doubled the brilliancy of the moon, which in this void of ether unfavourable to diffusion did not eclipse the neighbouring stars. The sky, thus seen, presented quite a different aspect—one that no human eye could imagine.

It will be readily understood with what interest these audacious men contemplated the moon, the supreme goal of their journey. The earth's satellite, in her movement of translation, insensibly neared the zenith, a mathematical point which she was to reach about ninety-six hours later. Her mountains and plains, or any object in relief, were not seen more plainly than from the earth; but her light across the void was developed with incomparable intensity. The disc shone like a platinum mirror. The travellers had already forgotten all about the earth which was flying beneath their feet.

It was Captain Nicholl who first drew attention to the vanished globe.

"Yes!" answered Michel Arden. "We must not be ungrateful to it. As we are leaving our planet let our last looks reach it. I want to see the earth before it disappears completely from our eyes!"

Barbican, to satisfy the desires of his companion, occupied himself with clearing the window at the bottom of the projectile, the one through which they could observe the earth directly. The movable floor which the force of projection had sent to the bottom was taken to pieces, not without difficulty; its pieces, carefully placed against the sides, might still be of use. Then appeared a circular bay window, half a yard wide, cut in the lower part of the projectile. It was filled with glass five inches thick, strengthened with metal settings. Under it was an aluminium plate, held down by bolts. The screws taken out and the bolts withdrawn, the plate fell back, and visual communication was established between interior and exterior.

Michel Ardan knelt upon the glass. It was dark, and seemed opaque.

"Well," cried he, "but where's the earth?"

"There it is," said Barbicane.

"What!" cried Ardan, "that thin streak, that silvery crescent?"

"Certainly, Michel. In four days' time, when the moon is full, at the very minute we shall reach her, the earth will be new. She will only appear to us under the form of a slender crescent, which will soon disappear, and then she will be buried for some days in impenetrable darkness."

"That the earth!" repeated Michel Ardan, staring at the thin slice of his native planet.

The explanation given by President Barbicane was correct. The earth, looked at from the projectile, was entering her last quarter. She was in her octant, and her crescent was clearly outlined on the dark background of the sky. Her light, made bluish by the thickness of her atmosphere, was less intense than that of the lunar crescent. This crescent then showed itself under considerable dimensions. It looked like an enormous arch stretched across the firmament. Some points, more vividly lighted, especially in its concave part, announced the presence of high mountains; but they disappeared sometimes under black spots, which are never seen on the surface of the lunar disc. They were rings of clouds placed concentrically round the terrestrial spheroid.

However, by dint of a natural phenomenon, identical with that produced on the moon when she is in her octants, the contour of the terrestrial globe could be traced. Its entire disc appeared slightly visible through an effect of pale light, less appreciable than that of the moon. The reason of this lessened intensity is easy to understand. When this reflection is produced on the moon it is caused by the sun's rays which the earth reflects upon her satellite. Here it was caused by the sun's rays reflected from the moon upon the earth. Now terrestrial light is thirteen times more intense than lunar light on account of the difference of volume in

the two bodies. Hence it follows that in the phenomenon of the pale light the dark part of the earth's disc is less clearly outlined than that of the moon's disc, because the intensity of the phenomenon is in proportion to the lighting power of the two stars. It must be added that the terrestrial crescent seems to form a more elongated curve than that of the disc—a pure effect of irradiation.

Whilst the travellers were trying to pierce the profound darkness of space, a brilliant shower of falling stars shone before their eyes. Hundreds of meteors, inflamed by contact with the atmosphere, streaked the darkness with luminous trails, and lined the cloudy part of the disc with their fire.

This was all they saw of the globe lost in the darkness, an inferior star of the solar world, which for the grand planets rises or sets as a simple morning or evening star! Imperceptible point in space, it was now only a fugitive crescent, this globe where they had left all their affections.

For a long time the three friends, not speaking, yet united in heart, watched while the projectile went on with uniformly decreasing velocity. Then irresistible sleep took possession of them. Was it fatigue of body and mind? Doubtless, for after the excitement of the last hours passed upon the earth, reaction must inevitably set in.

“Well,” said Michel, “as we must sleep, let us go to sleep.”

Stretched upon their beds, all three were soon buried in profound slumber.

But they had not been unconscious for more than a quarter of an hour when Barbicane suddenly rose, and, waking his companions, in a loud voice cried—

“I’ve found it!”

“What have you found?” asked Michel Ardan, jumping out of bed.

“The reason we did not hear the detonation of the Columbiad!”

“Well?” said Nicholl.

“It was because our projectile went quicker than sound.”



## CHAPTER III

### TAKING POSSESSION

THIS explanation once given, the three friends fell again into a profound sleep. Where would they have found a calmer or more peaceful place to sleep in? Upon earth, houses in the town or cottages in the country feel every shock upon the surface of the globe. At sea, ships, rocked by the waves, are in perpetual movement. This projectile alone, travelling in absolute void amidst absolute silence, offered absolute repose to its inhabitants.

The sleep of the three adventurers would have, perhaps, been indefinitely prolonged if an unexpected noise had not awakened them about 7 a.m. on the 2nd of December, eight hours after their departure.

This noise was a very distinct bark.

"The dogs! It is the dogs!" cried Michel Ardan, getting up immediately.

"They are hungry," said Nicholl.

"I should think so," answered Michel; "we have forgotten them."

"Where are they?" asked Barbicane.

One of the animals was found cowering under the divan. Terrified and stunned by the first shock, it had remained in a corner until the moment it had recovered its voice along with the feeling of hunger.

It was Diana, still rather sheepish, that came from the retreat, not without urging. Michel Ardan encouraged her with his most gracious words.

"Come, Diana," he said—"come, my child; your destiny will be noted in cynegetic annals! Pagans would have made you companion to the god Anubis, and Christians friend to St. Roch! You are worthy of being carved in bronze for

the king of hell, like the puppy that Jupiter gave beautiful Europa as the price of a kiss! Your celebrity will efface that of the Montargis and St. Bernard heroes. You are rushing through interplanetary space, and will, perhaps, be the Eve of Selenite dogs! You will justify up there Toussenel's saying, 'In the beginning God created man, and seeing how weak he was, gave him the dog!' Come, Diana, come here!"

Diana, whether flattered or not, came out slowly, uttering plaintive moans.

"Good!" said Barbicane. "I see Eve, but where is Adam?"

"Adam," answered Michel Ardan, "can't be far off. He is here somewhere. He must be called! Satellite! here, Satellite!"

But Satellite did not appear. Diana continued moaning. It was decided, however, that she was not hurt, and an appetizing dish was set before her to stop her complaining.

As to Satellite, he seemed lost. They were obliged to search a long time before discovering him in one of the upper compartments of the projectile, where a rather inexplicable rebound had hurled him violently. The poor animal was in a pitiable condition.

The unfortunate dog was carefully lowered. His head had been fractured against the roof, and it seemed difficult for him to survive such a shock. Nevertheless, he was comfortably stretched on a cushion, where he sighed once.

"We will take care of you," said Michel; "we are responsible for your existence. I would rather lose an arm than a paw of my poor Satellite."

So saying he offered some water to the wounded animal, who drank it greedily.

After attending the dogs the travellers attentively watched the earth and the moon. The earth only appeared like a pale disc terminated by a crescent smaller than that of the previous evening, but its volume compared with that of the moon, which was gradually forming a perfect circle, remained enormous.

"*Parbleu!*" then said Michel Ardan; "I am really sorry

we did not start when the earth was at her full—that is to say, when our globe was in opposition to the sun!”

“Why?” asked Nicholl.

“Because we should have seen our continents and seas under a new aspect—the continents shining under the sun’s rays, the seas darker, like they figure upon certain maps of the world! I should like to have seen those poles of the earth upon which the eye of man has never yet rested!”

“I dare say,” answered Barbicane, “but if the earth had been full the moon would have been new—that is to say, invisible amidst the irradiation of the sun. It is better for us to see the goal we want to reach than the place we started from.”

“You are right, Barbicane,” answered Captain Nicholl; “and besides, when we have reached the moon we shall have plenty of time during the long lunar nights to consider at leisure the globe that harbours men like us.”

“Men like us!” cried Michel Ardan. “But now they are not more like us than the Selenites. We are inhabitants of a new world peopled by us alone—the projectile! I am a man like Barbicane, and Barbicane is a man like Nicholl. Beyond us and outside of us humanity ends, and we are the only population of this microcosm until the moment we become simple Selenites.”

“In about eighty-eight hours,” replied the captain.

“Which means?” asked Michel Ardan.

“That it is half-past eight,” answered Nicholl.

“Very well,” answered Michel, “I fail to find the shadow of a reason why we should not breakfast.”

In fact, the inhabitants of the new star could not live in it without eating. Michel Ardan, in his quality of Frenchman, declared himself chief cook, an important function that no one disputed with him.

The breakfast began with three cups of excellent broth, due to the liquefaction in hot water of three precious Liebig tablets, prepared from the choicest morsels of the Pampas ruminants. Some slices of beefsteak succeeded them, and



were as tender and succulent as if they had just come from the butchers of the Paris Café Anglais. Michel, an imaginative man, would have it they were even rosy.

Preserved vegetables, "fresher than the natural ones," as the amiable Michel observed, succeeded the meat, and were followed by some cups of tea and slices of bread and butter, American fashion. Lastly, as a worthy ending to the meal, Ardan ferreted out a fine bottle of "Nuits" burgundy that "happened" to be in the provision compartment. The three friends drank it to the union of the earth and her satellite.

And as if the generous wine it had distilled upon the hill-sides of Burgundy were not enough, the sun was determined to help in the feast. The projectile at that moment emerged from the cone of shadow cast by the terrestrial globe, and the sun's rays fell directly upon the lower disc, on account of the angle which the orbit of the moon makes with that of the earth.

"The sun!" exclaimed Michel Ardan.

"Of course," answered Barbicane; "I expected it."

"But," said Michel, "the cone of shadow thrown by the earth into space extends beyond the moon."

"Much beyond if you do not take the atmospheric refraction into account," said Barbicane. "But when the moon is enveloped in that shadow the centres of the three heavenly bodies—the sun, the earth, and the moon—are in a straight line. Then the nodes coincide with the full moon and there is an eclipse. If, therefore, we had started during an eclipse of the moon all our journey would have been accomplished in the dark, which would have been a pity."

"Why?"

"Because, although we are journeying in the void, our projectile, bathed in the solar rays, will gather their light and heat; therefore there will be economy of gas, a precious economy in every way."

In fact, under these rays, the temperature and brilliancy of which there was no atmosphere to soften, the projectile

was lighted and warmed as if it had suddenly passed from winter to summer.

"It is pleasant here now," said Nicholl.

"I believe you!" cried Michel Ardan. "With a little vegetable soil spread over our aluminium planet we could grow green peas in twenty-four hours. I have only one fear, that is that the walls of our craft will melt."

"You need not alarm yourself, my worthy friend," answered Barbicane. "The projectile supported a much higher temperature while it was travelling through the atmosphere. I should not even wonder if it looked to the eyes of the spectators like a fiery meteor."

"Then J. T. Maston must think we are roasted!"

"What I am astonished at," answered Barbicane, "is that we are not. It was a danger we did not foresee."

"I feared it," answered Nicholl simply.

"And you did not say anything about it, sublime captain!" cried Michel Ardan, shaking his companion's hand.

In the meantime Barbicane was making his arrangements in the projectile as though he was never going to leave it. It will be remembered that its base was fifty-four feet square. It was twelve feet high, and admirably fitted up in the interior. It was not much encumbered by the instruments and travelling utensils, which were all in special places, and it left some liberty of movement to its three inhabitants. The thick glass let into a part of the floor could bear considerable weight. Barbicane and his companions walked upon it as well as upon a solid floor; but the sun, which struck it directly with its rays, lighting the interior of the projectile from below, produced unusual effects of light.

They began by examining the state of the water and provision containers. They were not in the least damaged, thanks to the precautions taken to deaden the shock. The provisions were abundant, and sufficient for one year. Barbicane took this precaution in case the projectile should arrive upon an absolutely barren part of the moon. There



was only enough water and brandy for two months. But according to the latest observations of astronomers, the moon had a dense low and thick atmosphere at least in its deepest valleys, and there must be streams and water-courses. Therefore the adventurous explorers would not suffer from hunger or thirst during the journey, and the first year upon the lunar continent.

The question of air in the interior of the projectile also offered all security. The Reiset and Regnaut apparatus, destined to produce oxygen, was furnished with enough chlorate of potass for two months. It necessarily consumed a large quantity of gas, for it was obliged to keep the productive matter up to  $100^{\circ}$ . But there was abundance of that also. The apparatus wanted little looking after as it worked automatically. At that high temperature the chlorate of potass changed into chlorine of potassium, and gave out all the oxygen it contained. The eighteen pounds of chlorate of potass gave out the seven pounds of oxygen necessary for the daily consumption of the three travellers.

But it was not enough to renew the oxygen consumed; the carbonic acid gas produced by expiration must also be absorbed. Now for the last twelve hours the atmosphere of the cabin had become loaded with this deleterious gas, the product of the combustion of the elements of blood by the oxygen taken into the lungs. Nicholl perceived this state of the air by seeing Diana breathing heavily. In fact, carbonic acid gas—through a phenomenon identical with the one to be noticed in the famous Dog's Grotto—accumulated at the bottom of the projectile by reason of its weight. Poor Diana, whose head was low down, therefore necessarily suffered from it before her masters. But Captain Nicholl made haste to remedy this state of things. He placed on the floor of the projectile several receptacles containing caustic potass which he shook about for some time, and this matter, which is very greedy of carbonic acid, completely absorbed it, and thus purified the air.

An inventory of the instruments was then begun. The

thermometers and barometers were undamaged, with the exception of a minimum thermometer, the glass of which was broken. An excellent aneroid was taken out of its padded box and hung upon the wall. Of course it was only acted upon by and indicated the pressure of the air inside the projectile; but it also indicated the quantity of moisture it contained. At that moment its needle oscillated between 25.24 and 25.08. It was at "set fair."

Barbicané had brought several compasses, which were found intact. It will be easily understood that under those circumstances their needles were acting at random, without any constant direction. In fact, at the distance the projectile was from the earth the magnetic pole could not exercise any sensible action upon the apparatus. But these compasses, taken upon the lunar disc, might reveal some particular phenomena. In any case it would be interesting to verify whether the earth's satellite, like the earth herself, submitted to magnetical influence.

A hypsometer to measure the altitude of the lunar mountains, a sextant to take the height of the sun, a theodolite, an instrument for surveying, telescopes to be used as the moon approached—all these instruments were carefully inspected and found in good condition, notwithstanding the violence of the initial shock.

As to the equipment—pickaxes, spades, and different tools—of which Nicholl had made a special collection, the sacks of various kinds of grain, and the shrubs which Michel Ardan counted upon transplanting into moon's soil, they were in their places in the upper corners of the projectile. There was made a sort of granary, which the prodigal Frenchman had filled. What was in it was very little known, and the merry fellow did not enlighten anybody. From time to time he climbed up the cramp-irons riveted in the walls to this store-room, the inspection of which he had reserved to himself. He arranged and re-arranged, plunged his hand rapidly into certain mysterious boxes, singing all the time in a voice very out of tune, some old French song.

Barbicané noticed with interest that his rockets, etc., were not damaged. These were important, for, powerfully loaded, they were meant to slacken the speed with which the projectile would, when attracted by the moon after passing the point of neutral attraction, fall upon her surface. This fall besides would be six times less rapid than it would have been upon the surface of the earth, thanks to the difference of mass in the two bodies.

The inspection ended, therefore, in general satisfaction. Then they all returned to their posts of observation at the lateral and lower port-lights.

The same spectacle was spread before them. All the extent of the celestial sphere swarmed with stars and constellations of marvellous brilliancy, enough to make an astronomer wild! On one side the sun, like the mouth of a fiery furnace, shone upon the dark background of the heavens. On the other side the moon, reflecting back his fires, seemed motionless amidst the starry world. Then a large spot, like a hole in the firmament, bordered still by a slight thread of silver—it was the earth. Here and there nebulous masses like large snow-flakes, and from zenith to nadir an immense ring, formed of an impalpable dust of stars—the milky way in which the sun only counts as a star of the fourth magnitude!

The observers could not take their eyes off a spectacle so new, of which no description could give any idea. What reflections it suggested! What unknown emotions it aroused in the soul! Barbicané wished to begin the recital of his journey under the empire of these impressions, and he noted down hourly all the events that signalized the beginning of his enterprise. He wrote tranquilly in his large and rather commercial-looking handwriting.

During that time the calculating Nicholl looked over the formulæ of trajectories, and worked away at figures with unparalleled dexterity. Michel Ardan talked sometimes to Barbicané, who did not answer much, to Nicholl, who did not hear, and to Diana, who did not understand his

theories, and lastly to himself, making questions and answers, going and coming, occupying himself with a thousand details, sometimes leaning over the lower port-light, sometimes roosting in the heights of the projectile, singing all the time.

The day, or rather—for the expression is not correct—the lapse of twelve hours which makes a day upon earth—was ended by a copious supper carefully prepared. No incident of a nature to shake the confidence of the travellers had happened, so, full of hope and already sure of success, they went to sleep peacefully, whilst the projectile, at a uniformly increasing speed, made its way in the heavens.



## CHAPTER IV

### A LITTLE ALGEBRA

THE night passed without incident. Correctly speaking, the word "night" is an improper one. The position of the projectile in regard to the sun did not change. Astronomically it was day on the bottom of the projectile, and night on the top. When, therefore, these two words are used they express the lapse of time between the rising and setting of the sun upon earth.

The travellers' sleep was so much the more peaceful because, notwithstanding its excessive speed, the projectile seemed absolutely motionless. No movement indicated its journey through space. However rapidly change of place may be effected, it cannot produce any sensible effect upon the organism when it takes place in the void, or when the mass of air circulates along with the travelling body. What inhabitant of the earth perceives the speed which carries him along at the rate of 68,000 miles an hour? Movement under such circumstances is not felt more than rest. Every object is indifferent to it. When a body is at rest it remains so until some foreign force puts it in movement. When in motion it would never stop if some obstacle were not placed in its path. This indifference to movement or rest is inertia.

Barbicane and his companions could, therefore, imagine themselves absolutely motionless, shut up in the interior of the projectile. The effect would have been the same if they had placed themselves on the outside. Without the moon, which grew larger above them, and the earth that grew smaller below, they would have sworn they were suspended.

That morning, the 3rd of December, they were awakened by a joyful but unexpected noise. It was the crowing of a cock in the interior of their vehicle.

Michel Ardan was the first to get up; he climbed to the top of the projectile and closed a partly open case.

"Be quiet," said he in a whisper. "That animal will spoil my plan!"

In the meantime Nicholl and Barbicane awoke.

"Was that a cock?" said Nicholl.

"No, my friends," answered Michel quickly. "I wished to awake you with that rural sound."

So saying he gave vent to a cock-a-doodle-do which would have done honour to the proudest of cocks.

The two Americans could not help laughing.

"A fine accomplishment that," said Nicholl, looking suspiciously at his companion.

"Yes," answered Michel, "a joke common in my country. It is very Gallic. We perpetrate it in the best society."

Then turning the conversation—

"Barbicane, do you know what I have been thinking about all night?"

"No," answered the president.

"About our friends at Cambridge. You have already remarked how ignorant I am of mathematics. I find it, therefore, impossible to guess how our friends at the observatory could calculate what initial velocity the projectile ought to reach on leaving the Columbiad in order to reach the moon."

"You mean," replied Barbicane, "in order to reach that neutral point where the terrestrial and lunar attractions are equal; for beyond this point, situated at about 0.9 of the distance, the projectile will fall upon the moon by virtue of its own weight."

"Very well," answered Michel; "but once more; how did they calculate the initial velocity?"

"Nothing is easier," said Barbicane.

"And could you have made the calculation yourself?" asked Michel Ardan.

"Certainly; Nicholl and I could have determined it if the report from the observatory had not saved us the trouble."

"Well, old fellow," answered Michel, "they might sooner

cut off my head, beginning with my feet, than have made me solve that problem!"

"Because you do not know algebra," replied Barbicane tranquilly.

"Ah, that's just like you dealers in  $x$ ! You think you have explained everything when you have said 'algebra.' "

"Michel," replied Barbicane, "do you think it possible to forge without a hammer, or to plough without a plough-share?"

"It would be difficult."

"Well, then, algebra is a tool like a plough or a hammer, and a good tool for anyone who knows how to use it."

"Seriously?"

"Quite."

"Could you use that tool before me?"

"If it would interest you."

"And could you show me how they calculated the initial speed of our vehicle?"

"Yes, my worthy friend. By taking into account all the elements of the problem, the distance from the centre of the earth to the centre of the moon, of the radius of the earth, the mass of the earth and the mass of the moon, I can determine exactly what the initial speed of the projectile ought to be, and that by a very simple formula."

"Show me the formula."

"You shall see it. Only I will not give you the curve really traced by the projectile between the earth and the moon, by taking into account their movement of translation round the sun. No. I will consider both bodies to be motionless, and that will be sufficient for us."

"Why?"

"Because that would be seeking to solve the problem called 'the problem of the three bodies,' for which the integral calculus is not yet far enough advanced."

"Indeed," said Michel Ardan in a bantering tone; "then mathematics have not said their last word."

"Certainly not," answered Barbicane.

"Good! Perhaps the Selenites have pushed the integral calculus further than you! By the by, what is the integral calculus?"

"It is the inverse of the differential calculus," answered Barbicane seriously.

"Much obliged."

"It is the algebra of change."

"That is clear at least," answered Barbicane with a quite satisfied air.

"And now," continued Barbicane, "for a piece of paper and a pencil, and in half an hour I will have found the required formula."

That said, Barbicane became absorbed in his work, whilst Nicholl looked into space, leaving the care of preparing breakfast to his companion.

Half an hour had scarcely elapsed before Barbicane, raising his head, showed Michel Ardan a page covered with algebraical signs amidst which the following general formula was discernible:—

$$\frac{1}{2}(v^2 - v_0^2) = gr \left\{ \frac{r}{x} - 1 + \frac{m^1}{m} \left( \frac{r}{d-x} - \frac{r}{d-r} \right) \right\}$$

"And what does that mean?" asked Michel.

"That means," answered Nicholl, "that the half of  $v$  minus  $v$  zero square equals  $gr$  multiplied by  $r$  upon  $x$  square minus 1 plus  $m$  prime upon  $m$  multiplied by  $r$  upon  $d$  minus  $x$ , minus  $r$  upon  $d$  minus  $r$ ——"

" $x$  upon  $y$  galloping upon  $z$  and rearing upon  $p$ ," cried Michel Ardan, bursting out laughing. "Do you mean to say you understand that, captain?"

"Nothing is clearer."

"Then," said Michel Ardan, "it is as plain as a pikestaff, and I want nothing more."

"Everlasting laughter," said Barbicane, "you wanted algebra, and now you shall have it over head and ears."

"I would rather be hung!"

"That appears a good solution, Barbicane," said Nicholl,



who was examining the formula like a *connaissanceur*. "It is the integral of the equation of 'vis viva,' and I do not doubt that it will give us the desired result."

"But I should like to understand!" exclaimed Michel. "I would give ten years of Nicholl's life to understand!"

"Then listen," resumed Barbicane. "The half of  $v$  minus  $v$  zero square is the formula that gives us the demi-variation of the 'vis viva.' "

"Good; and does Nicholl understand what that means?"

"Certainly, Michel," answered the captain. "All those signs that look so cabalistic to you form the clearest and most logical language for those who know how to read it."

"And do you pretend, Nicholl," asked Michel, "that by means of these hieroglyphics, more incomprehensible than those of the Egyptian, you can find the initial speed necessary to give to the projectile?"

"Incontestably," answered Nicholl; "and even by that formula I could always tell you what speed it is going at on any point of the journey."

"Upon your word of honour?"

"Yes."

"Then you are as clever as our president."

"No, Michel, all the difficulty consists in what Barbicane has done. It is to establish an equation which takes into account all the conditions of the problem. The rest is only a question of arithmetic and requires nothing but a knowledge of the four rules."

"That's something," answered Michel Ardan, who had never been able to make a correct addition in his life, and who thus defined the rule: "A Chinese puzzle, by which you can obtain infinitely various results."

Still Barbicane answered that Nicholl would certainly have found the formula had he thought about it.

"I do not know if I should," said Nicholl, "for the more I study it the more marvellously correct I find it."

"Now listen," said Barbicane to his ignorant comrade, "and you will see that all these letters have a signification."

"I am listening," said Michel, looking resigned.

" $D$ ," said Barbicane, "is the distance from the centre of the earth to the centre of the moon, for we must take the centres to calculate the attraction."

"That I understand."

"— $R$  is the radius of the earth."

"— $R$ , radius; admitted."

"— $M$  is the mass of the earth;  $m$  *prime* that of the moon. We are obliged to take into account the volume of the two attracting bodies, as the attraction is in proportion to the mass."

"I understand that."

"— $g$  represents the constant of gravity, the speed acquired at the end of a second by a body falling to the surface of the earth. Is that clear?"

"A mountain stream!" answered Michel.

"Now I represent by  $x$  the variable distance that separates the projectile from the centre of the earth, and by  $v$  the velocity the projectile has at that distance."

"Good."

"Lastly, the expression  $v$  zero which figures in the equation is the speed the body possesses when it emerges from the atmosphere."

"Yes," said Nicholl, "you were obliged to calculate the velocity from that point, because we knew before that the velocity at departure is exactly equal to  $\frac{2}{3}$  of the velocity upon emerging from the atmosphere."

"Don't understand any more!" said Michel.

"Yet it is very simple," said Barbicane.

"I do not find it very simple," replied Michel.

"It means that when our projectile reached the limit of the terrestrial atmosphere it had already lost one-third of its initial velocity."

"As much as that?"

"Yes, my friend, simply by friction against the atmosphere. You will easily understand that the greater its speed the more resistance it would meet with from the air."

"That I admit," answered Michel, "and I understand it, although your  $v$  zero two and your  $v$  zero square shake about in my head like nails in a sack."

"First effect of algebra," continued Barbicane. "And now to finish we are going to find the numerical known quantity of these different expressions—that is to say, find out their value."

"You will finish me first!" answered Michel.

"Some of these expressions," said Barbicane, "are known; the others have to be calculated."

"I will calculate those," said Nicholl.

"And  $r$ ," resumed Barbicane, " $r$  is the radius of the earth at the latitude of Florida, our point of departure,  $d$ —that is to say, the distance from the centre of the earth to the centre of the moon equals fifty-six terrestrial radii——"

Nicholl rapidly calculated.

"That makes 356,720,000 metres when the moon is at her perigee—that is to say, when she is nearest to the earth."

"Very well," said Barbicane, "now  $m$  prime upon  $m$ —that is to say, the proportion of the moon's mass to that of the earth equals  $\frac{1}{81}$ ."

"Perfect," said Michel.

"And  $g$ , the gravity, is to Florida  $9\frac{1}{81}$  metres. From whence it results that  $gr$  equals——"

"Sixty-two million four hundred and twenty-six thousand square metres," answered Nicholl.

"What next?" asked Michel Ardan.

"Now that the expressions are reduced to figures, I am going to find the velocity  $v$  zero—that is to say, the velocity that the projectile ought to have on leaving the atmosphere to reach the point of equal attraction with no velocity. The velocity at that point I make equal *zero*, and  $x$ , the distance where the neutral point is, will be represented by the nine-tenths of  $d$ —that is to say, the distance that separates the two centres."

"I have some vague idea that it ought to be so," said Michel.

"I shall then have,  $x$  equals nine-tenths of  $d$ , and  $v$  equals zero, and my formula will become——"

Barbicané wrote rapidly on the paper—

$$v_0^2 = 2gr \left\{ 1 - \frac{10r}{9d} \cdot \frac{1}{81} \left( \frac{10r}{d} - \frac{r}{d-r} \right) \right\}$$

Nicholl read it quickly.

"That's it! that is it!" he cried.

"Is it clear?" asked Barbicané.

"It is written in letters of fire!" answered Nicholl.

"Clever fellows!" murmured Michel.

"Do you understand now?" asked Barbicané.

"If I understand!" cried Michel Ardan. "My head is bursting with it."

"Thus," resumed Barbicané, " $v$  zero square equals  $2gr$  multiplied by 1 minus  $10r$  upon  $9d$  minus  $\frac{1}{81}$  multiplied by  $10r$  upon  $d$  minus  $r$  upon  $d$  minus  $r$ ."

"And now," said Nicholl, "in order to obtain the velocity of the body as it emerges from the atmosphere I have only to calculate."

The captain, like a man used to overcome all difficulties, began to calculate with frightful rapidity. Divisions and multiplications grew under his fingers. Figures dotted the page. Barbicané followed him with his eyes, whilst Michel Ardan compressed a coming headache with his two hands.

"Well, what do you make it?" asked Barbicané after several minutes' silence.

"I make it 11,051 metres in the first second."

"What do you say?" said Barbicané, starting.

"Eleven thousand and fifty-one metres."

"Malediction!" cried the president with a gesture of despair.

"What's the matter with you?" asked Michel Ardan, much surprised.

"The matter! Why if at this moment the velocity was already diminished one-third by friction, the initial speed ought to have been——"



“Sixteen thousand five hundred and seventy-six metres!” answered Nicholl.

“But the Cambridge Observatory declared that 11,000 metres were enough at departure, and our projectile started with that velocity only!”

“Well?” asked Nicholl.

“Why it was not enough!”

“No.”

“We shall not reach the neutral point.”

“The devil!”

“We shall not even go half-way!”

“*Nom d'un boulet!*” exclaimed Michel Ardan, jumping up as if the projectile were on the point of striking against the terrestrial globe.

“And we shall fall back upon the earth!”

## CHAPTER V

### THE TEMPERATURE OF SPACE

THIS revelation acted like a thunderbolt. Who could have expected such an error in calculation? Barbicane would not believe it. Nicholl went over the figures again. They were correct. The formula which had established them could not be mistrusted, and, when verified, the initial velocity of 16,576 metres, necessary for attaining the neutral point, was found quite right.

The three friends looked at one another in silence. No one thought about breakfast after that. Barbicane, with set teeth, contracted brow, and fists convulsively closed, looked through the port-light. Nicholl folded his arms and examined his calculations. Michel Ardan murmured—

“That’s just like experts! That’s the way they always do! I would give anything to fall upon the Cambridge Observatory and crush it, with all its stupid staff inside!”

All at once the captain made a reflection which struck Barbicane at once.

“Why,” said he, “it is seven o’clock in the morning, so we have been thirty-two hours on the road. We have come more than half-way, and we are not falling yet that I know of!”

Barbicane did not answer, but after a rapid glance at the captain he took a compass, which he used to measure the angular distance of the terrestrial globe. Then through the lower port-light he made a very exact observation from the apparent immobility of the projectile. Then rising and wiping the perspiration from his brow, he put down some figures upon paper. Nicholl saw that the president wished to find out from the length of the terrestrial diameter their distance from the earth. He looked at him anxiously.

"No!" cried Barbicane in a few minutes' time, "we are not falling! We are already more than 50,000 leagues from the earth! We have passed the point the projectile ought to have stopped at if its speed had been only 11,000 metres at our departure! We are still ascending!"

"That is evident," answered Nicholl; "so we must conclude that our initial velocity, under the propulsion of the 400,000 lbs. of gun-cotton, was greater than the 11,000 metres. I can now explain to myself why we met with the second satellite, that gravitates at more than 2,000 leagues from the earth, in less than thirteen minutes."

"That explanation is so much the more probable," added Barbicane, "because by throwing out the water in our movable partitions the projectile was made considerably lighter all at once."

"That is true," said Nicholl.

"Ah, my brave Nicholl," cried Barbicane, "we are saved!"

"Very well then," answered Michel Ardan tranquilly, "as we are saved, let us have breakfast."

Nicholl was not mistaken. The initial speed had happily been greater than that indicated by the Cambridge Observatory, but the Cambridge Observatory had been mistaken.

The travellers, recovered from their false alarm, sat down to table and breakfasted merrily. Though they ate much they talked more. Their confidence was greater after the "algebra incident."

"Why should we not succeed?" repeated Michel Ardan. "Why should we not arrive? We are on the road; there are no obstacles before us, and no stones on our route. It is free—freer than that of a ship that has to struggle with the sea, or a balloon with the wind against it! Now if a ship can go where it pleases, or a balloon ascend where it pleases, why should not our projectile reach the goal it was aimed at?"

"It will reach it," said Barbicane.

"If only to honour the American nation," added Michel Ardan, "the only nation capable of making such an enter-

prise succeed—the only one that could have produced a President Barbicane! Ah! now I think of it, now that all our anxieties are over, what will become of us? We shall be as dull as stagnant water.”

Barbicane and Nicholl made gestures of protest.

“But I foresaw this, my friends,” resumed Michel Ardan. “You have only to say the word. I have chess, backgammon, cards and dominoes at your disposition. We only want a billiard-table!”

“What?” asked Barbicane, “did you bring such trifles as those?”

“Certainly,” answered Michel; “not only for our amusement, but also in the praiseworthy intention of bestowing them upon Selenite inns.”

“My friend,” said Barbicane, “if the moon is inhabited its inhabitants appeared some thousands of years before those of the earth, for it cannot be doubted that the moon is older than the earth. If, therefore, the Selenites have existed for thousands of centuries—if their brains are organized like that of human beings—they have invented all that we have invented already, and even what we shall only invent in the lapse of centuries. They will have nothing to learn from us, and we shall have everything to learn from them.”

“What!” answered Michel, “do you think they have had artists like Phidias, Michael Angelo, or Raphael?”

“Yes.”

“Poets like Homer, Virgil, Milton, Lamartine, and Hugo?”

“I am sure of it.”

“Philosophers like Plato, Aristotle, Descartes, and Kant?”

“I have no doubt of it.”

“Scientists like Archimedes, Euclid, Pascal, and Newton?”

“I could swear it.”

“Clowns like Arnal, and photographers like—Nadar?”

“I am certain of it.”

“Then, friend Barbicane, if these Selenites are as learned



as we, and even more so, why have they not hurled a lunar projectile as far as the terrestrial regions?"

"Who says they have not done it?" answered Barbicane seriously.

"In fact," added Nicholl, "it would have been easier for them than for us, and that for two reasons—the first because the attraction is six times less on the surface of the moon than on the surface of the earth, which would allow a projectile to go up more easily; secondly the projectile would only have 8,000 leagues to travel instead of 80,000, which would require a force of propulsion ten times less."

"Then," resumed Michel, "I repeat—why have they not done it?"

"And I" replied Barbicane, "I repeat—who says they have not done it?"

"When?"

"Hundreds of centuries ago, before man's appearance upon earth."

"And the projectile? Where is the projectile? I ask to see it!"

"My friend," answered Barbicane, "the sea covers five-sixths of our globe, hence there are five good reasons for supposing that the lunar projectile, if it has been fired, is now submerged at the bottom of the Atlantic or Pacific, unless it was buried down some abyss at the epoch when the earth's crust was not sufficiently formed."

"Old fellow," answered Michel, "you have an answer to everything, and I bow before your wisdom. There is one hypothesis I would rather believe than the others, and it is that the Selenites being older than we are wiser and have not invented gunpowder at all."

At that moment Diana claimed her share in the conversation by a sonorous bark. She asked for her breakfast.

"Ah!" said Michel Ardan, "our arguments make us forget Diana and Satellite!"

A good dish of food was immediately offered to the dog, who devoured it with great appetite.

"Do you know, Barbicane," said Michel, "we ought to have made this projectile a sort of Noah's Ark, and have taken a couple of all the domestic animals with us to the moon."

"No doubt," answered Barbicane, "but we should not have had room enough."

"Oh, we might have been packed a little tighter!"

"The fact is," answered Nicholl, "that oxen, cows, bulls, and horses, all those ruminants would be useful on the lunar continent. Unfortunately we cannot make our projectile either a stable or a cowshed."

"But at least," said Michel Ardan, "we might have brought an ass, nothing but a little ass, the courageous and patient animal old Silenus loved to exhibit. I am fond of those poor asses! They are the least favoured animals in creation. They are not only beaten during their lifetime, but are still beaten after their death!"

"What do you mean by that?" asked Barbicane.

"Why, don't they use his skin to make drums of?"

Barbicane and Nicholl could not help laughing at this absurd reflection. But a cry from their merry companion stopped them; he was bending over Satellite's niche, and rose up saying:

"Good! Satellite is no longer ill."

"Ah!" said Nicholl.

"No!" resumed Michel, "he is dead. Now," he added in a pitiful tone, "this will be embarrassing! I very much fear, poor Diana, that you will not leave any of your race in the lunar regions!"

The unfortunate Satellite had not been able to survive his wounds. He was dead, stone dead. Michel Ardan, much put out of countenance, looked at his friends.

"This makes another difficulty," said Barbicane. "We can't keep the dead body of this dog with us for another eight-and-forty hours."

"No, certainly not," answered Nicholl, "but our port-lights are hung upon hinges. They can be let down. We will open one of them, and throw the body into space."

The president reflected for a few minutes, and then said: "Yes, that is what we must do, but we must take the most minute precautions."

"Why?" asked Michel.

"For two reasons that I will explain to you," answered Barbicane. "The first has reference to the air in the projectile, of which we must lose as little as possible."

"But we can renew the air!"

"Not entirely. We can only renew the oxygen, Michel; and, by the bye we must be careful that the apparatus do not furnish us with this oxygen in an immoderate quantity, for an excess of it would cause grave physiological consequences. But although we can renew the oxygen we cannot renew the azote, that medium which the lungs do not absorb, and which ought to remain intact. Now the azote would rapidly escape if the port-lights were opened."

"Not just the time necessary to throw poor Satellite out."

"Agreed; but we must do it quickly."

"And what is the second reason?" asked Michel.

"The second reason is that we must not allow the exterior cold, which is excessive, to penetrate into our projectile lest we should be frozen alive."

"Still the sun——"

"The sun warms our projectile because it absorbs its rays, but it does not warm the void we are in now. When there is no air there is no more heat than there is diffused light, and where the sun's rays do not reach directly it is both dark and cold. The temperature outside is only that produced by the radiation of the stars—that is to say, the same as the temperature of the terrestrial globe would be if one day the sun were to be extinguished."

"No fear of that," answered Nicholl.

"Who knows?" said Michel Ardan. "And even supposing that the sun be not extinguished, it might happen that the earth will move farther away from it."

"Good!" said Nicholl; "that's one of Michel's ideas!"

"Well," resumed Michel, "it is well known that in 1861



the earth went through the tail of a comet. Now suppose there was a comet with a power of attraction greater than that of the sun, the terrestrial globe might make a curve towards the wandering star, and the earth would become its satellite, and would be dragged away to such a distance that the rays of the sun would have no action on its surface."

"That might happen certainly," answered Barbicane, "but the consequences would not be so redoubtable as you would suppose."

"How so?"

"Because heat and cold would still be pretty well balanced upon our globe. It has been calculated that if the earth had been carried away by the comet of 1861, it would only have felt, when at its greatest distance from the sun, a heat sixteen times greater than that sent to us by the moon—a heat which, when focused by the strongest lens, produces no appreciable effect."

"Well?" said Michel.

"Wait a little," answered Barbicane. "It has been calculated that at its perihelion, when nearest to the sun, the earth would have borne a heat equal to 28,000 times that of summer. But this heat, capable of vitrifying terrestrial matters, and of evaporating water, would have formed a thick circle of clouds which would have lessened the excessive heat, hence there would be compensation between the cold of the aphelion and the heat of the perihelion, and an average probably supportable."

"At what number of degrees do they estimate the temperature of the planetary space?"

"Formerly," answered Barbicane, "it was believed that this temperature was exceedingly low. By calculating its thermometric diminution it was fixed at millions of degrees below zero. It was Fourier, one of Michel's countrymen, an illustrious scientist of the *Académie des Sciences*, who reduced these numbers to a more accurate estimation. According to him, the temperature of space does not get lower than 60° Centigrade."



Michel whistled.

"It is about the temperature of the polar regions," answered Barbicane, "at Melville Island or Fort Reliance—about  $56^{\circ}$  Centigrade below zero."

"It remains to be proved," said Nicholl, "that Fourier was not mistaken in his calculations. If I am not mistaken, another Frenchman, M. Pouillet, estimates the temperature of space at  $160^{\circ}$  below zero. We shall be able to verify that."

"Not now," answered Barbicane, "for the solar rays striking directly upon our thermometer would give us, on the contrary, a very high temperature. But when we get upon the moon, during the nights, a fortnight long, which each of its faces endures alternately, we shall have leisure to make the experiment, for our satellite moves in the void."

"What do you mean by the void?" asked Michel; "is it absolute void?"

"It is absolutely void of air."

"Is there nothing in its place?"

"Yes, ether," answered Barbicane.

"Ah! and what is ether?"

"Ether, my friend, is an agglomeration of imponderable particles, which, relatively to their dimensions, are as far removed from each other as the celestial bodies are in space. It is these atoms that by their vibrating movement produce light and heat by making four hundred and thirty billions of oscillations a second."

"Millions of millions!" exclaimed Michel Ardan; "then scientists have measured and counted these oscillations! All these figures, friend Barbicane, are scientists' figures, which reach the ear, but say nothing to the mind."

"But they are obliged to have recourse to figures."

"No. It would be much better to compare. A billion signifies nothing. An object of comparison explains everything. Example—When you tell me that Uranus is 76 times larger than the earth, Saturn 900 times larger, Jupiter 1,300 times larger, the sun 1,300,000 times larger, I am not much wiser. So I much prefer the comparisons that simply tells

you, 'The sun is a pumpkin two feet in diameter, Jupiter an orange, Saturn a Blenheim apple, Neptune a large cherry, Uranus a smaller cherry, the earth a pea, Venus a green pea, Mars the head of a large pin, Mercury a grain of mustard, and Juno, Ceres, Vesta, and Pallas fine grains of sand'! Then I know what it means!"

After this tirade of Michel Ardan's against the scientists and their billions, which he delivered without stopping to take breath, they set about burying Satellite. He was to be thrown into space like sailors throw a corpse into the sea.

As President Barbicane had recommended, they had to act quickly so as to lose as little air as possible. The bolts upon the right-hand port-hole were carefully unscrewed, and an opening of about half a yard made, whilst Michel prepared to hurl his dog into space. The window, worked by a powerful lever, which conquered the pressure of air in the interior upon the sides of the projectile, moved upon its hinges, and Satellite was thrown out. Scarcely a particle of air escaped, and the operation succeeded so well that later on Barbicane did not fear to get rid of all the useless rubbish that encumbered the vehicle in the same way.

## CHAPTER VI

### QUESTIONS AND ANSWERS

ON the 4th of December, at 5 a.m. by terrestrial reckoning, the travellers awoke, having been fifty-four hours on their journey. They had only been five hours and forty minutes more than half the time assigned for the accomplishment of their journey, but they had come more than seven-tenths of the distance. This peculiarity was due to their regularly-increasing speed.

When they looked at the earth through the port-light at the bottom, it only looked like a black spot drowned in the sun's rays. No crescent or pale light was now to be seen. The next day at midnight the earth would be new at the precise moment when the moon would be full. Above the Queen of Night was nearing the line followed by the projectile, so as to meet it at the hour indicated. All around the dark vault was studded with brilliant specks which seemed to move slowly; but through the great distance they were at their relative size did not seem to alter much. The sun and the stars appeared exactly as they do from the earth. The moon was considerably enlarged; but the travellers' not very powerful telescopes did not as yet allow them to make very useful observations of her surface or to reconnoitre the topographical or geological details.

The time went by in interminable conversations. The talk was especially about the moon. Each contributed his share of particular knowledge. Barbicane's and Nicholl's were always serious, Michel Ardan's always fanciful. The projectile, its situation and direction, the incidents that might arise, the precautions necessitated by its fall upon the moon, all this afforded inexhaustible material for conjecture.

Whilst breakfasting a question of Michel's provoked a

rather curious answer from Barbicane, and one worthy of being recorded.

Michel, supposing the projectile to be suddenly stopped whilst still endowed with its formidable initial velocity, wished to know what the consequences would have been.

"But," answered Barbicane, "I don't see how the projectile could have been stopped."

"But let us suppose it," answered Nicholl.

"It is an impossible supposition," replied the practical president, "unless the force of impulsion had failed. But in that case its speed would have gradually decreased and it would not have stopped abruptly."

"Admit that it had struck against some body in space."

"What body?"

"The enormous meteor we met."

"Then," said Nicholl, "the projectile would have been broken into a thousand pieces, and we with it."

"More than that," answered Barbicane, "we should have been burnt alive."

"Burnt!" exclaimed Michel. "I regret it did not happen for us just to see."

"And you would have seen with a vengeance," answered Barbicane. "It is known that heat is only a form of motion, when water is heated—that is to say, when heat is added to it—the particles of which it is composed are set in movement."

"That is an ingenious theory!" said Michel.

"And a correct one, my worthy friend, for it explains all the known phenomena. Heat is only molecular movement, a simple oscillation of the particles of a body. Do you understand?"

"Admirably," answered Michel. "For example, when I have been running some time, and am covered with sweat, why am I forced to stop? Simply because my movement has been transformed into heat."

Barbicane could not help laughing at this *repartie* of Michel's. Then resuming his theory—



"Thus," said he, "in case of a collision, the same would have happened to our projectile as does to a metal cannon-ball after striking armour-plate; it would fall burning, because its movement had been transformed into heat. In consequence, I affirm that if our projectile had struck the asteroid, its speed, suddenly annihilated, would have produced heat enough to turn it immediately into vapour."

"Then," asked Nicholl, "what would happen if the earth were to be suddenly stopped in her movement?"

"Her temperature would be carried to such a point," answered Barbicane, "that she would be immediately reduced to vapour."

"Good," said Michel; "that means of ending the world would simplify many things."

"And suppose the earth were to fall upon the sun?" said Nicholl.

"According to calculations," answered Barbicane, "that would develop a heat equal to that produced by 1,600 globes of coal, equal to the mass of the earth."

"A good increase of temperature for the sun," replied Michel Ardan, "of which the inhabitants of Uranus or Neptune will probably not complain, for they must be dying of cold on their planet."

"Thus, then, my friends, any movement suddenly stopped produces heat. This theory makes one suppose that the sun is constantly fed by an incessant fall of bodies upon its surface. It has been calculated——"

"Now I shall be crushed," murmured Michel, "for figures are coming."

"It has been calculated," continued Barbicane imperturbably, "that the shock of each asteroid upon the sun must produce heat equal to that of 4,000 masses of coal of equal volume."

"And what is the heat of the sun?" asked Michel.

"It is equal to that which would be produced by a stratum of coal surrounding the sun to a depth of twenty-seven kilometres."

"And that heat——"

"Could boil 2,900,000,000 of cubic myriametres of water an hour." (A myriametre is equal to rather more than 6·2138 miles, or 6 miles 1 furlong 28 poles.)

"And we are not roasted by it?" cried Michel.

"No," answered Barbicane, "because the terrestrial atmosphere absorbs four-tenths of the solar heat. Besides, the quantity of heat intercepted by the earth is only two thousand millionth of the total."

"I see that all is for the best," replied Michel, "and that our atmosphere is a useful invention, for it not only allows us to breathe, but actually prevents us roasting."

"Yes," said Nicholl, "but, unfortunately, it will not be the same on the moon."

"Bah!" said Michel, always confident. "If there are any inhabitants they breathe. If there are no longer any they will surely have left enough oxygen for three people, if only at the bottom of those ravines where it will have accumulated by reason of its weight! Well, we shall not climb the mountains! That is all."

And Michel, getting up, went to look at the lunar disc, which was shining with fantastic brilliancy.

"Faith!" said he, "it must be hot up there."

"Without reckoning," answered Nicholl, "that daylight lasts 360 hours."

"And by way of compensation night has the same duration," said Barbicane, "and as heat is restored by radiation, their temperature must be that of planetary space."

"A fine country truly!" said Nicholl.

"Never mind! I should like to be there already! It will be comical to have the earth for a moon, to see it rise on the horizon, to recognize the continents, to say to oneself, 'There's America and there's Europe'; then to follow it till it is lost in the rays of the sun. By the by, Barbicane, have the Selenites any eclipses?"

"Yes, eclipses of the sun," answered Barbicane, "when the centres of the three stars are on the same line with the

earth in the middle. But they are merely annular eclipses, during which the earth, thrown like a screen across the solar disc, allows the greater part to be seen."

"Why is there no total eclipse?" asked Nicholl. "Is it because the cone of shade thrown by the earth does not extend beyond the moon?"

"Yes, if you do not take into account the refraction produced by the earth's atmosphere, not if you do take that refraction into account. Thus, let *delta* be the horizontal parallax and *p* the apparent semidiameter——"

"Ouf!" said Michel, "half of  $v$  zero square! Do speak the vulgar tongue, man of algebra!"

"Well, then, in popular language," answered Barbicane, "the mean distance between the moon and the earth being sixty terrestrial radii, the length of the cone of shadow, by dint of refraction, is reduced to less than forty-two radii. It follows, therefore, that during the eclipses the moon is beyond the cone of pure shade, and the sun sends it not only rays from its edges, but also rays from its centre."

"Then," said Michel in a grumbling tone, "why is there any eclipse when there ought to be none?"

"Solely because the solar rays are weakened by the refraction, and the atmosphere which they traverse extinguishes the greater part of them."

"That reason satisfies me," answered Michel; "besides, we shall see for ourselves when we get there. Now, Barbicane, do you believe that the moon is an ancient comet?"

"What an idea!"

"Yes," replied Michel, with amiable conceit, "I have a few ideas of that kind."

"But that idea does not originate with Michel," answered Nicholl.

"Then I am only a plagiarist."

"Without doubt," answered Nicholl. "According to the testimony of the ancients, the Arcadians pretended that their ancestors inhabited the earth before the moon became her satellite. Starting from this fact, certain thinkers consider

the moon was a comet which its orbit one day brought near enough to the earth to be retained by terrestrial attraction."

"And what truth is there in that hypothesis?" asked Michel.

"None," answered Barbicane, "and the proof is that the moon has not kept a trace of the gaseous envelope that always accompanies comets."

"But," said Nicholl, "might not the moon, before becoming the earth's satellite, have passed near enough to the sun to leave all her gaseous substances by evaporation?"

"It might, friend Nicholl, but it is not probable."

"Why?"

"Because—because, I really don't know."

"Ah, what hundreds of volumes we might fill with what we don't know!" exclaimed Michel. "But I say," he continued, "what time is it?"

"Three o'clock," answered Nicholl.

"How the time goes," said Michel, "in the conversation of thinkers like us! I feel that I am becoming a well of knowledge!"

So saying, Michel climbed to the roof of the projectile, "in order better to observe the moon," he pretended. In the meanwhile his companions watched the vault of space through the lower port-light. There was nothing fresh to report.

When Michel Ardan came down again he approached the lateral port-light, and suddenly uttered an exclamation of surprise.

"What is the matter now?" asked Barbicane.

The president approached the glass and saw a sort of flattened sack floating outside at some yards' distance from the projectile. This object seemed motionless like the projectile.

"Whatever can that machine be?" said Michel Ardan.

"Is it one of the corpuscles of space which our projectile holds in its field of attraction, and which will accompany it as far as the moon?"



"What I am astonished at," answered Nicholl, "is that the specific weight of this body, which is certainly superior to that of the projectile, allows it to maintain itself so rigorously on its level."

"Nicholl," said Barbicane, after a moment's reflection, "I do not know what that object is, but I know perfectly why it keeps on a level with the projectile."

"Why, pray?"

"Because we are floating in the void where bodies fall or move—which is the same thing—with equal speed whatever their weight or form may be. It is the air which, by its resistance, creates differences in weight. When you create a void in a tube, the objects you throw down it, either lead or feathers, fall with the same speed. Here in space you have the same cause and the same effect."

"True," said Nicholl, "and all we throw out of the projectile will accompany us to the moon."

"Ah! what fools we are!" cried Michel.

"Why this qualification?" asked Barbicane.

"Because we ought to have filled the projectile with useful objects, books, instruments, tools, etc. We could have thrown them all out, and they would all have followed in our wake! But, now I think of it, why can't we take a walk outside? Why can't we go into space through the port-light? What delight it would be to be thus suspended in ether, more favoured even than birds that are forced to flap their wings to sustain them!"

"Agreed," said Barbicane, "but how are we to breathe?"

"Confound the air!"

"But if it did not fail, Michel, your density being inferior to that of the projectile, you would soon remain behind."

"Then it is a vicious circle."

"All that is most vicious."

"And we must remain imprisoned in our vehicle."

"Yes, we must."

"Ah!" cried Michel in a formidable voice.

"What is the matter with you?" asked Nicholl.

“I know, I guess what this pretended asteroid is! It is not a broken piece of planet!”

“What is it, then?” asked Nicholl.

“It is our unfortunate dog! It is Diana’s husband!”

In fact, this deformed object, now quite unrecognizable, was the body of Satellite!

## CHAPTER VII

### A MOMENT OF MADNESS

THUS a curious but logical phenomenon took place under these singular conditions. Every object thrown out of the projectile would follow the same path and only stop when it did. That furnished a text for conversation which the whole evening could not exhaust. The emotion of the three travellers increased as they approached the end of their journey. They expected unforeseen incidents, fresh phenomena—in fact nothing would have astonished them under present circumstances. Their excited imagination outdistanced the projectile, the speed of which diminished notably without their feeling it. But the moon grew larger before their eyes, and they thought they had only to stretch out their hands to touch it.

The next day, the 5th of December, they were all wide awake at 5 a.m. That day was to be the last of their journey if the calculations were exact. That same evening, at midnight, within eighteen hours, at the precise moment of full moon, they would reach her brilliant disc. The next midnight would bring them to the goal of their journey, the most extraordinary one of ancient or modern times. At early dawn, through the windows made silvery with her rays, they saluted the Queen of Night with a confident and joyful hurrah.

The moon was sailing majestically across the starry firmament. A few more degrees and she would reach that precise point in space where the projectile was to meet her. According to his own observations, Barbicane thought that he should accost her in her northern hemisphere, where vast plains extend and mountains are rare—a favourable circumstance if the lunar atmosphere was, according to expert opinion, stored up in deep places only.

"Besides," observed Michel Ardan, "a plain is more suitable for landing upon than a mountain. A Selenite who landed in Europe on the summit of Mont Blanc, or in Asia on a peak of the Himalayas, would not be precisely at his destination!"

"What is more," added Nicholl, "on a plain the projectile will remain motionless after it has touched the ground, whilst it would roll down a hill like an avalanche, and as we are not squirrels we should not come out safe and sound. Therefore all is for the best."

In fact, the success of the audacious enterprise no longer appeared doubtful. Still one reflection occupied Barbicane; but not wishing to make his two companions uneasy, he kept silent about it.

The direction of the projectile towards the northern hemisphere proved that its trajectory had been slightly modified. The aim, mathematically calculated, ought to have sent it into the very centre of the lunar disc. If it did not arrive there it would be because it had deviated. What had caused it? Barbicane could not imagine nor determine the importance of this deviation, for there was no datum to go upon. He hoped, however, that the only result would be to take them towards the upper edge of the moon, a more suitable region for landing.

Barbicane, therefore, without saying anything to his friends, contented himself with frequently observing the moon, trying to see if the direction of the projectile would not change. For the situation would have been so terrible had the projectile, missing its aim, been dragged beyond the lunar disc and fallen into interplanetary space.

At that moment the moon, instead of appearing flat like a disc, already showed her convexity. If the sun's rays had reached her obliquely the shadow then thrown would have made the high mountains stand out. They could have seen the gaping craters and the capricious furrows that cut up the immense plains. But all relief was levelled in the intense brilliancy. Those large spots that give the ap-



pearance of a human face to the moon were scarcely distinguishable.

"It may be a face," said Michel Ardan, "but I am sorry for the amiable sister of Apollo, her face is so freckled!"

In the meantime the travellers so near their goal ceaselessly watched this new world. Their imagination made them take walks over these unknown countries. They climbed the elevated peaks. They descended to the bottom of the large amphitheatres. Here and there they thought they saw vast seas scarcely kept together under an atmosphere so rarefied, and streams of water that poured them their tribute from the mountains. Leaning over the abyss they hoped to catch the noise of this orb for ever mute in the solitudes of the void.

This last day left them the liveliest remembrances. They noted down the smallest details. A vague uneasiness took possession of them as they approached their goal. This uneasiness would have been doubled if they had known how slight their speed was. It appeared quite insufficient to take them to the end of their journey. This was because the projectile scarcely "weighed" anything. Its weight constantly decreased, and would be entirely annihilated on that line where the lunar and terrestrial attractions neutralize each other, causing surprising effects.

Nevertheless, in spite of his preoccupations, Michel Ardan did not forget to prepare the morning meal with his habitual punctuality. They ate heartily. Nothing was more excellent than their broth liquefied by the heat of the gas. Nothing better than these preserved meats. A few glasses of good French wine crowned the meal, and caused Michel Ardan to remark that the lunar vines, warmed by this ardent sun, ought to distil the most generous wines—that is, if they existed. Any way, the far-seeing Frenchman had taken care not to forget in his collection some precious cuttings of the Médoc and Côte d'Or.

The Reiset and Regnault apparatus always worked with extreme precision. The air was kept in a state of perfect

purity. Not a particle of carbonic acid resisted the potass, and as to the oxygen, that, as Captain Nicholl said, was of "first quality." The small amount of humidity in the projectile mixed with this air and tempered its dryness.

But in order to work efficiently this apparatus had to be kept going regularly. Each morning Michel inspected the escape regulators, tried the taps, and fixed by the pyrometer the heat of the gas. All had gone well so far, and the travellers, imitating the worthy J. T. Maston, began to get so stout that they would not be recognizable if their imprisonment lasted several months. They behaved like chickens in a cage—they fattened.

Looking through the port-lights Barbicane saw the spectre of the dog, and the different objects thrown out of the projectile, which obstinately accompanied it. Diana howled lamentably when she perceived the remains of Satellite. All the things seemed as motionless as if they had rested upon solid ground.

"Do you know, my friends," said Michel Ardan, "that if one of us had succumbed to the recoil shock at departure we should have been much embarrassed as to how to get rid of him? You see, the accusing corpse would have followed us in space like remorse!"

"That would have been sad," said Nicholl.

"Ah!" continued Michel, "what I regret is our not being able to take a walk outside. What delight it would be to float in this radiant ether, to bathe in these pure rays of the sun! If Barbicane had only thought of furnishing us with diving-dresses and air-pumps I should have ventured outside, and have assumed the attitude of a flying-horse on the summit of the projectile."

"Ah, old fellow!" answered Barbicane, "you would not have stayed there long in spite of your diving-dress; you would have burst by the expansion of air inside you, or rather like a balloon that goes up too high. So regret nothing, and do not forget this: while we are moving in the void you must do without any sentimental promenade out of the projectile."

Michel Ardan allowed himself to be convinced in a certain measure. He agreed that the thing was difficult, but not "impossible"; that was a word he never uttered.

The conversation passed from this subject to another, and never languished an instant. It seemed to the three friends that under these conditions ideas came into their heads like leaves in the first warm days of spring.

Amidst the questions and answers that crossed each other during this morning, Nicholl asked one that did not get an immediate answer.

"I say," said he, "it is all very well to go to the moon, but how shall we get back again?"

"What do you mean by that, Nicholl?" asked Barbicane gravely.

"It seems to me very inopportune to ask about getting away from a country before you get to it," added Michel.

"I don't ask that question because I want to draw back, but I repeat my question, and ask, 'How shall we get back?'"

"I have not the least idea," answered Barbicane.

"And as for me," said Michel, "if I had known how to come back I should not have gone."

"That is what you call answering," cried Nicholl.

"I approve of Michel's words, and add that the question has no actual interest. We will think about that later on, when we want to return. Though the Columbiad will not be there, the projectile will."

"Much good that will be, a bullet without a gun!"

"A gun can be made, and so can powder! Neither metal, saltpetre, nor coal can be wanting in the bowels of the moon. Besides, in order to return you have only the lunar attraction to conquer, and you will only have 8,000 leagues to go so as to fall on the terrestrial globe by the simple laws of weight."

"That is enough," said Michel, getting animated. "Let us hear no more about returning. As to communicating with our ancient colleagues upon earth, that will not be difficult."

"How are we to do that, pray?"



"By means of meteors hurled by the lunar volcanoes."

"A good idea, Michel," answered Barbicane. "Laplace has calculated that a force five times superior to that of our cannons would suffice to send a meteor from the moon to the earth. Now there is no volcano that has not a superior force of propulsion."

"Hurrah! cried Michel. "Meteors will be convenient postmen and will not cost anything! And how we shall laugh at the postal service! But now I think——"

"What do you think?"

"A superb idea! Why did we not fasten a telegraph wire to our projectile? We could have exchanged telegrams with the earth!"

"And the weight of a wire 86,000 leagues long," answered Nicholl, "does that go for nothing?"

"Yes, for nothing! We should have trebled the charge of the Columbiad! We could have made it four times—five times—greater!" cried Michel, whose voice became more and more violent.

"There is a slight objection to make to your project," answered Barbicane. "It is that during the movement of rotation of the globe our wire would have been rolled round it like a chain round a windlass, and it would inevitably have dragged us down to the earth again."

"By the thirty-nine stars of the Union!" said Michel, "I have nothing but impracticable ideas to-day—ideas worthy of J. T. Maston! But now I think of it, if we do not return to earth J. T. Maston will certainly come to us!"

"Yes! he will come," replied Barbicane; "he is a worthy and courageous comrade. Besides, what could be easier? Is not the Columbiad still lying in Floridian soil? Will not the moon again pass the zenith of Florida? In another eighteen years will she not occupy exactly the same place that she occupies to-day?"

"Yes," repeated Michel—"yes, Maston will come, and with him our friends Elphinstone, Blomsberry, and all the members of the Gun Club, and they will be welcome! Later



on trains of projectiles will be established between the earth and the moon! Hurrah for J. T. Maston!"

It is probable that if the Honourable J. T. Maston did not hear the hurrahs uttered in his honour his ears tingled at least. What was he doing then? He was no doubt stationed in the Rocky Mountains at Long's Peak, trying to discover the invisible body gravitating in space. If he was thinking of his dear companions it must be acknowledged that they were thinking of him.

But whence came the animation that grew visibly greater in the inhabitants of the projectile? Their sobriety could not be questioned. Must this strange erethismus of the brain be attributed to the exceptional circumstances of the time, to that proximity of the Queen of Night from which a few hours only separated them, or to some secret influence of the moon acting on their nervous system? Their faces became as red as if exposed to the heat of a furnace; their respiration became more active, and their lungs played like forge-bellows; their eyes shone with extraordinary flame, and their voices became formidably loud, their words escaped like a champagne-cork driven forth by carbonic acid gas; their gestures became disquieting, they wanted so much room to perform them in. And, strange to say, they in no wise perceived this excessive tension of the mind.

"Now," said Nicholl in a sharp tone—"now that I do not know whether we shall come back from the moon, I will know what we are going there for!"

"What we are going there for!" answered Barbicane, stamping as if he were in a fencing-room; "I don't know."

"You don't know!" cried Michel with a shout that provoked a sonorous echo in the projectile.

"No, I have not the least idea!" answered Barbicane, shouting in unison with his questioner.

"Well, then, I know," answered Michel.

"Speak, then," said Nicholl, who could no longer restrain the angry tones of his voice.



"I shall speak if it suits me!" cried Michel

"I shall speak if it suits me!" cried Michel, violently seizing his companion's arm.

"It must suit you!" said Barbicane, with eyes on fire and threatening hands. "It was you who drew us into this terrible journey, and we wish to know why!"

"Yes," said the captain, "if I don't know where I am going, I will know why I am going."

"Why?" cried Michel, jumping a yard high—"why? To take possession of the moon in the name of the United States! To add a fortieth State to the Union! To colonize the lunar regions, to cultivate them, people them, to take them all the wonders of art, science, and industry! To civilize the Selenites, unless they are more civilized than we are, and to make them into a republic if they have not already done it for themselves!"

"If there are any Selenites!" answered Nicholl, who under the force of this inexplicable intoxication became very contradictory.

"Who says there are no Selenites?" cried Michel in a threatening tone.

"I do!" shouted Nicholl.

"Captain," said Michel, "do not repeat that insult or I will knock your teeth down your throat!"

The two adversaries were about to rush upon one another, and this incoherent discussion was threatening to degenerate into a battle, when Barbicane interfered.

"Stop, unhappy men," said he, putting his two companions back to back, "if there are no Selenites, we will do without them!"

"Yes!" exclaimed Michel, who did not care more about them than that. "We have nothing to do with the Selenites! Bother the Selenites!"

"The empire of the moon shall be ours," said Nicholl. "Let us found a Republic of three!"

"I shall be the Congress," cried Michel.

"And I the Senate," answered Nicholl.

"And Barbicane the President," shouted Michel.

"No President elected by the nation!" answered Barbicane.

"Well, then, a President elected by the Congress," exclaimed Michel; "and as I am the Congress I elect you unanimously."

"Hurrah! hurrah! hurrah for President Barbicane!" exclaimed Nicholl.

"Hip—hip—hip! hurrah!" screamed Michel Ardan.

Then the President and Senate struck up "Yankee Doodle" as loudly as they could, whilst the Congress shouted the virile "Marseillaise."

Then began a frantic dance with maniacal gestures, mad stamping, and somersaults of boneless clowns. Diana took part in the dance, howling too, and jumped to the very roof of the projectile. An inexplicable flapping of wings and cock-crows of singular sonority were heard. Five or six fowls flew about striking the walls like mad bats.

Then the three travelling companions, whose lungs were disorganized under some incomprehensible influence, more than intoxicated, burnt by the air that had set their breathing apparatus on fire, fell motionless upon the bottom of the projectile.



## CHAPTER VIII

### AT SEVENTY-EIGHT THOUSAND ONE HUNDRED AND FOURTEEN LEAGUES

WHAT had happened? What was the cause of that singular madness, the consequences of which might prove so disastrous? Simply carelessness on Michel's part, which Nicholl was able to remedy in time.

After a swoon, which lasted a few minutes, the captain, who was the first to regain consciousness, soon collected his thoughts.

Although he had breakfasted two hours before, he began to feel as hungry as if he had not tasted food for several days. His whole being, his brain and stomach, were excited to the highest point.

He rose, therefore, and demanded some action from Michel, who was still unconscious, and did not answer. Nicholl, therefore, proceeded to prepare some cups of tea.

Imagine his surprise when he struck a match to see the sulphur burn with extraordinary and almost unbearable brilliancy! From the jet of gas he lighted rose a flame equal to floods of electric light.

A revelation took place in Nicholl's mind. This intensity of light, the physiological disturbance in himself, the extra excitement of all his moral and sensitive faculties—he understood it all.

"The oxygen!" he exclaimed.

And leaning over the air-apparatus, he saw that the tap was giving out a flood of colourless and odourless gas, eminently vital, but which in a pure state produces the gravest disorders. Through carelessness Michel had left the tap full on.

Nicholl made haste to turn off this flow of oxygen with which the atmosphere was saturated, and which would have caused the death of the travellers, not by suffocation, but by combustion.

An hour afterwards the air was relieved, and gave normal play to the lungs. By degrees the three friends recovered from their intoxication; but they were obliged to recover from their oxygen like a drunkard from his wine.

When Michel knew his share of responsibility in this incident he did not appear in the least disconcerted. This unexpected intoxication broke the monotony of the journey. Many foolish things had been said under its influence, but they had been forgotten as soon as said.

"Then," added the merry Frenchman, "I am not sorry for having experienced the effect of this capitous gas. Do you know, my friends, that there might be a curious establishment set up with oxygen-rooms, where people whose constitutions are weak might live a more active life during a few hours at least? Suppose we had meetings where the air could be saturated with this heroic fluid, theatres where the managers would send it out in strong doses, what passion there would be in the souls of actors and spectators, what fire and what enthusiasm! And if, instead of a simple assembly, a whole nation could be saturated with it, what activity, what a supplement of life it would receive! Of an exhausted nation it perhaps would make a great and strong nation, and I know more than one state in old Europe that ought to put itself under the oxygen *régime* in the interest of its health."

Michel spoke with as much animation as if the tap were still full on. But with one sentence Barbicane damped his enthusiasm.

"All that is very well, friend Michel," he said, "but now perhaps you will tell us where those fowls that joined in our concert came from."

"Those fowls?"

"Yes."

In fact, half a dozen hens and a superb cock were flying hither and thither.

"Ah, the stupids!" cried Michel. "It was the oxygen that put them in revolt."

"But what are you going to do with those fowls?" asked Barbicane.

"Acclimatize them on the moon of course! For the sake of a joke, my worthy president; simply a joke that has unhappily come to nothing! I wanted to let them out on the lunar continent without telling you! How astounded you would have been to see these terrestrial poultry pecking the fields of the moon!"

"Ah, *gamin*, you eternal boy!" answered Barbicane, "you don't want oxygen to make you out of your senses! You are always what we were under the influence of this gas! You are always insane!"

"Ah! how do we know we were not wiser then?" replied Michel Ardan.

After this philosophical reflection the three friends repaired the disorder in the projectile. Cock and hens were put back in their cage. But as they were doing this Barbicane and his two companions distinctly perceived a fresh phenomenon.

Since the moment they had left the earth their own weight, that of the projectile and the objects it contained, had suffered progressive diminution. Though they could not have any experience of this in the projectile, a moment must come when the effect upon themselves and the tools and instruments they used would be felt.

Of course scales would not have indicated this loss of weight, for the weights used would have lost precisely as much as the object itself; but a spring weighing-machine, the tension of which is independent of attraction, would have given the exact valuation of this loss.

It is well known that attraction, or weight, is in proportion to the mass, and in inverse proportion to the square of distances. Hence this consequence. If the earth had been

alone in space, if the other heavenly bodies were to be suddenly annihilated, the projectile, according to Newton's law, would have weighed less according to its distance from the earth, but without ever losing its weight entirely, for the terrestrial attraction would always have made itself felt, no matter at what distance.

But in the case with which we are dealing, a moment must come when the projectile would not be at all under the law of gravitation, after allowing for the other celestial bodies, whose effect could not be set down as zero.

In fact, the trajectory of the projectile was between the earth and the moon. As it went farther away from the earth gravitational attraction would be diminished in inverse proportion to the square of distances, but the lunar attraction would be augmented in the same proportion. A point must, therefore, be reached where these two attractions would neutralize each other, and the projectile would have no weight at all. If the masses of the moon and earth were equal, this point would have been reached at an equal distance between the two bodies. But by taking their difference of mass into account it was easy to calculate that this point would be situated at  $\frac{1}{52}$  of the journey, or at 78,114 leagues from the earth.

At this point a body that had no velocity or movement in itself would remain eternally motionless, being equally attracted by the two heavenly bodies, and nothing drawing it more towards one than the other.

Now if the force of impulsion had been exactly calculated the projectile ought to reach that point with no velocity, having lost all weight like the objects it contained.

What would happen then? Three theories presented themselves.

Either the projectile would have kept some velocity, and passing the point of equal attraction, would fall on the moon by virtue of the excess of the moon's attraction over the earth's attraction.

Or velocity sufficient to reach the neutral point being



wanting, it would fall back on the earth by virtue of the excess of terrestrial attraction over lunar attraction.

Or lastly, endowed with sufficient velocity to reach the neutral point, but insufficient to pass it, it would remain eternally suspended in the same place, like the pretended coffin of Mahomet, between the zenith and nadir.

Such was the situation, and Barbicane clearly explained the consequences to his travelling companions. How were they to know when they had reached this neutral point, situated at 78,114 leagues from the earth, at the precise moment when neither they nor the objects contained in the projectile should be in any way subject to the laws of weight?

Until now the travellers, though they had remarked that this action diminished little by little, had not yet perceived its total absence. But that day, about 11 a.m., Nicholl having let a tumbler escape from his hand, instead of falling, it remained suspended in the air.

"Ah!" cried Michel Ardan, "this is a little amusing chemistry!"

And immediately different objects, weapons, bottles, etc., left to themselves, hung suspended as if by miracle. Diana, too, lifted up by Michel into space, reproduced, but without trickery, the marvellous suspensions effected by Robert Houdin and Maskelyne and Cook.

The three adventurous companions, surprised and stupefied in spite of their scientific reasoning, felt weight go out of their bodies. When they stretched out their arms they felt no inclination to drop them. Their heads wobbled on their shoulders. Their feet no longer kept at the bottom of the projectile. They were like staggering drunkards. Imagination has created men deprived of their reflection, others deprived of their shadows! But here reality, by the neutrality of active forces, made men in whom nothing had any weight, and who weighed nothing themselves.

Suddenly Michel, making a slight spring, left the floor and remained suspended in the air like the good monk in Murillo's *Cuisine des Anges*. His two friends joined him in

an instant, and all three, in the centre of the projectile, looked like figures in a miraculous ascension.

"Is it believable? Is it likely? Is it possible?" cried Michel. "No. And yet it exists! Ah! if Raphael could have seen us like this what an Assumption he could have put upon canvas!"

"The Assumption cannot last," answered Barbicane. "If the projectile passes the neutral point, the lunar attraction will draw us to the moon."

"Then our feet will rest upon the roof of the projectile," answered Michel.

"No," said Barbicane, "because the centre of gravity in the projectile is very low, and it will turn over gradually."

"Then all our things will be turned upside down for certain!"

"Do not alarm yourself, Michel," answered Nicholl. "There is nothing of the kind to be feared. Not an object will move; the projectile will turn insensibly."

"In fact," resumed Barbicane, "when it has cleared the point of equal attraction, its bottom, relatively heavier, will drag it perpendicularly down to the moon. But in order that such a phenomenon should take place we must pass the neutral line."

"Passing the neutral line!" cried Michel. "Then let us do like the sailors who pass the equator—let us water our passage!"

A slight side movement took Michel to the padded wall. Thence he took a bottle and glasses, placed them "in space" before his companions, and merrily touching glasses, they saluted the line.

This influence of the attractions lasted scarcely an hour. The travellers saw themselves insensibly lowered towards the bottom, and Barbicane thought he remarked that the conical end of the projectile deviated slightly from the normal direction towards the moon. By an inverse movement the bottom side approached it. Lunar attraction was therefore gaining over terrestrial attraction. The fall towards the

moon began, insensibly as yet; it could only be that of a millimetre ( $\cdot 03937$  inch) and a third in the first second. But the attractive force would gradually increase, the fall would be more accentuated, the projectile, dragged down by its bottom side, would present its cone to the earth, and would fall with increasing velocity until it reached the moon's surface. Now nothing could prevent the success of the enterprise, and Nicholl and Michel Ardan shared Barbicane's joy.

Then they chatted about all the phenomena that had astounded them one after another, especially about the neutralization of the laws of weight. Michel Ardan, always full of enthusiasm, wished to deduce consequences which were only pure imagination.

"Ah! my worthy friends," he cried, "what progress we should make could we but get rid upon earth of this weight, this chain that rivets us to her! It would be the prisoner restored to liberty! There would be no more weariness either in arms or legs. And if it is true that, in order to fly upon the surface of the earth, to sustain yourself in the air by a simple action of the muscles, it would take a force 150 times superior to that we possess, a simple act of will, a caprice, would transport us into space, and attraction would not exist."

"In fact," said Nicholl, laughing, "if they succeeded in suppressing gravitation, like pain is suppressed by anæsthesia, it would change the face of modern society!"

"Yes," cried Michel, full of his subject, "let us destroy weight and have no more burdens! No more cranes, screw-jacks, windlasses, cranks, or other machines will be wanted."

"Well said," replied Barbicane; "but if nothing had any weight nothing would keep in its place, not even the hat on your head, worthy Michel; nor your house, the stones of which only adhere by their weight! Not even ships, whose stability upon the water is only a consequence of weight. Not even the ocean, whose waves would no longer be held in equilibrium by terrestrial attraction. Lastly, not even the



atmosphere, the molecules of which, being no longer held together, would disperse into space!"

"That is a pity," replied Michel. "There is nothing like positive people for recalling you brutally to reality!"

"Nevertheless, console yourself, Michel," resumed Barbicane, "for if no star could exist from which the laws of weight were banished, you are at least going to pay a visit where gravity is much less than upon earth."

"The moon?"

"Yes, the moon, on the surface of which objects weigh six times less than upon the surface of the earth, a phenomenon very easy to demonstrate."

"And shall we perceive it?" asked Michel.

"Evidently, for 400 lbs. only weigh 66 lbs. on the surface of the moon."

"Will not our muscular strength be diminished?"

"Not at all. Instead of jumping one yard you will be able to rise six."

"Then we shall be Hercules in the moon," cried Michel.

"Yes," replied Nicholl, "and the more so because if the height of the Selenites is in proportion to the bulk of their globe they will be hardly a foot high."

"Lilliputians!" replied Michel. "Then I am going to play the *rôle* of Gulliver! We shall realize the fable of the giants! That is the advantage of leaving one's own planet to visit the solar world!"

"But if you want to play Gulliver," answered Barbicane, "only visit the inferior planets, such as Mercury, Venus, or Mars, whose bulk is rather less than that of the earth. But do not venture into the big planets, Jupiter, Saturn, Uranus, Neptune, for there the *rôles* would be reversed, and you would become Lilliputian."

"And in the sun?"

"In the sun, though its density is four times less than that of the earth, its volume is thirteen hundred and twenty-four thousand times greater, and gravitation there is twenty-seven times greater than upon the surface of our globe."



Every proportion kept, the inhabitants ought on an average to be two hundred feet high."

"The devil!" exclaimed Michel. "I should only be a pigmy!"

"Gulliver amongst the giants," said Nicholl.

"Just so," answered Barbicane.

"It would not have been a bad thing to carry some weapons to defend oneself with."

"Good," replied Barbicane; "your bullets would have no effect on the sun, and they would fall to the ground in a few minutes."

"That's saying a great deal!"

"It is a fact," answered Barbicane. "Gravitation is so great on that enormous planet that an object weighing 70 lbs. on the earth would weigh 1,930 lbs. on the surface of the sun. Your hat would weigh 20 lbs.! your cigar  $\frac{1}{2}$  lb.! Lastly, if you fell on the solar continent your weight would be so great—about 5,000 lbs.—that you could not get up again."

"The devil!" said Michel, "I should have to carry about a portable crane! Well, my friends, let us be content with the moon for today. There, at least, we shall cut a great figure! Later on we shall see if we will go to the sun, where you can't drink without a crane to lift the glass to your mouth."

## CHAPTER IX

### THE CONSEQUENCES OF DEVIATION

BARBICANE had no fears about the issue of the journey, at least not about the projectile's force of impulsion. Its own speed would carry it beyond the neutral line. Therefore it would not return to the earth nor remain motionless at the point of attraction. One hypothesis only remained to be realized, the arrival of the projectile at its goal under the action of lunar attraction.

In reality it was a fall of 8,296 leagues upon a planet, it is true, where the gravity is six times less than upon the earth. Nevertheless it would be a terrible fall, and one against which all precautions ought to be taken without delay.

The precautions were of two sorts; some were for the purpose of deadening the shock at the moment the projectile would touch the moon's surface; others were to retard the shock.

In order to deaden the shock, it was a pity that Barbicane was no longer able to employ the means that had so usefully weakened the shock at departure—that is to say, the water used as a spring and the movable partitions. The partitions still existed, but water was wanting, for they could not use the reserve for this purpose—that would be precious in case there should be none on the moon.

Besides, this reserve would not have been sufficient for a spring. The layer of water store in the projectile at their departure, and on which lay the waterproof disc, occupied no less than three feet in depth, and spread over a surface of not less than fifty-four feet square. Now the receptacles did not contain the fifth part of that. They were, therefore, obliged to give up this means of deadening the shock.

Fortunately Barbicane, not content with employing water,

had furnished the movable disc with strong spring buffers, destined to lessen the shock against the bottom, after breaking the horizontal partitions. These buffers were still in existence; they had only to be fitted and the movable disc put in its place. All these pieces, easy to handle, as they weighed scarcely anything, could be rapidly mounted.

This was done. The different pieces were adjusted without difficulty. It was only a matter of bolts and screws. There were plenty of tools. The disc was soon fixed on its steel buffers like a table on its legs. One inconvenience resulted from this arrangement. The lower port-hole was covered, and it would be impossible for the travellers to observe the moon through that opening whilst they were descending perpendicularly upon her. But they were obliged to give it up. Besides, through the lateral openings they could still perceive the vast lunar regions, like the earth is seen from the car of a balloon.

Barbicané made fresh observations on the inclination of the projectile, but to his great vexation it had not turned sufficiently for a fall; it appeared to be describing a curve parallel with the lunar disc. The Queen of Night was shining splendidly in space, whilst opposite the orb of day was setting her on fire with his rays.

This situation soon became an anxious one.

"Shall we get there?" said Nicholl.

"We must act as though we should," answered Barbicané.

"You are faint-hearted fellows," replied Michel Ardan.

"We shall get there, and quicker than we want."

This answer recalled Barbicané to the work in hand and he occupied himself with placing the contrivances designed to retard the fall.

It should be appreciated that, at the meeting held in Tampa Town, Florida, Captain Nicholl appeared as Barbicané's enemy, and Michel Ardan's adversary. When Captain Nicholl said that the projectile would be broken like glass, Michel answered that he would retard the fall by means of fuses properly arranged.

In fact, powerful fuses, resting upon the bottom, and being fired outside, might, by producing a recoil action, lessen the speed of the projectile. These fuses were to burn in the void, it is true, but oxygen would not fail them, for they would furnish that themselves like the lunar volcanoes, the deflagration of which has never been prevented by the want of atmosphere around the moon.

Barbicane had therefore provided himself with fireworks shut up in little cannons of bored steel, which could be screwed on to the bottom of the projectile. Inside these cannons were level with the bottom; outside they went half a foot beyond it. There were twenty of them. All the effect took place outside. The exploding mixture had been already rammed into each gun. All they had to do, therefore, was to take up the metallic buffers fixed in the base, and to put these cannons in their place, where they fitted exactly.

This fresh work was ended about 3 p.m., and all precautions taken they had now nothing to do but to wait.

In the meantime the projectile visibly drew nearer the moon. It was, therefore, submitted in some proportion to its influence; but its own velocity also inclined it in an oblique line. Perhaps the result of these two influences would be a line that would become a tangent. But it was certain that the projectile was not falling normally upon the surface of the moon, for its base, by reason of its weight, ought to have been turned towards her.

Barbicane's anxiety was increased on seeing that his projectile resisted the influence of gravitation. It was the unknown that was before him—the unknown of the interstellar regions. He, the expert, believed that he had foreseen the only three hypotheses that were possible—the return to the earth, the fall upon the moon, or stagnation upon the neutral line! And here a fourth hypothesis, full of all the terrors of the infinite, cropped up. To face it without flinching took a resolute man like Barbicane, a phlegmatic being like Nicholl, or an audacious adventurer like Michel Ardan.



Conversation was started on this subject. Other men would have considered the question from a practical point of view. They would have wondered where the projectile would take them to. Not they, however. They sought the cause that had produced this effect.

"So we are off the line," said Michel. "But how is that?"

"I am very much afraid," answered Nicholl, "that notwithstanding all the precautions that were taken the Columbiad was not aimed correctly. The slightest error would suffice to throw us off course."

"Then the cannon was pointed badly?" said Michel.

"I do not think so," answered Barbicane. "The cannon was rigorously perpendicular, and its direction towards the zenith of the place was incontestable. The moon passing the zenith, we ought to have reached her at the full. There is another reason, but it escapes me."

"Perhaps we have arrived too late," suggested Nicholl.

"Too late?" said Barbicane.

"Yes," resumed Nicholl. "The notice from the Cambridge Observatory said that the transit ought to be accomplished in ninety-seven hours thirteen minutes and twenty seconds. That means that before that time the moon would not have reached the point indicated, and after she would have passed it."

"Agreed," answered Barbicane. "But we started on the 1st of December at 11h. 13m. 25s. p.m., and we ought to arrive at midnight on the 5th, precisely as the moon is full. Now this is the 5th of December. It is half-past three, and eight hours and a half ought to be sufficient to take us to our goal. Why are we not going towards it?"

"Perhaps the velocity was greater than it ought to have been," answered Nicholl, "for we know now that the initial velocity was greater than it was supposed to be."

"No! a hundred times no!" replied Barbicane. "An excess of velocity, supposing the direction of the projectile to have been correct, would not have prevented us reaching the moon. No! There has been a deviation. We have deviated!"

"Through whom? through what?" asked Nicholl.

"I cannot tell," answered Barbicane.

"Well, Barbicane," then said Michel, "should you like to know what I think about why we have deviated?"

"Say what you think."

"I would not give half a dollar to know! We have deviated, that is a fact. It does not matter much where we are going. We shall soon find out. As we are being carried along into space we shall end by falling into some centre of attraction or another."

Barbicane could not be contented with this indifference of Michel Ardan's. Not that he was anxious about the future. But what he wanted to know, at any price, was why his projectile had deviated.

In the meantime the projectile kept on its course sideways to the moon, and the objects thrown out along with it. Barbicane could even prove by the landmarks upon the moon, which was only at 2,000 leagues' distance, that its speed was becoming uniform—a fresh proof that they were not falling. Its force of impulsion was prevailing over the lunar attraction, but the trajectory of the projectile was certainly taking them nearer the lunar disc, and it might be hoped that at a nearer point the weight would predominate and enable a landing to be made.

The three friends, having nothing better to do, went on with their observations. They could not, however, yet make out clearly the surface details of the moon. Every relief was levelled under the action of the solar rays.

They watched thus through the lateral windows until 8 p.m. The moon then looked so large that she hid half the firmament from them. The sun on one side, and the Queen of Night on the other, flooded the projectile with light.

At that moment Barbicane thought he could estimate 700 leagues as the distance separating them from their goal. The velocity of the projectile appeared to him to be 200 yards a second, or about 170 leagues an hour. The base had a tendency to turn towards the moon under the influence of

the centripetal force; but the centrifugal force still predominated, and it became probable that the path would change to some curve the nature of which could not be determined.

Barbicané still sought the solution of this problem. The hours went by without result. The projectile visibly drew nearer to the moon, but it was plain that it could not reach her. The short distance at which it would pass her would be the result of two forces, attractive and repulsive, which acted upon the projectile.

"I only pray for one thing," repeated Michel, "and that is to pass near enough to the moon to penetrate her secrets."

"Confound the cause that made our projectile deviate!" cried Nicholl.

"Then," said Barbicané, as if he had been suddenly struck with an idea, "confound that asteroid that crossed our path!"

"Eh?" said Michel Ardan.

"What do you mean?" exclaimed Nicholl.

"I mean," resumed Barbicané, who appeared convinced, "I mean that our deviation is solely due to the influence of that wandering body."

"But it did not even graze us," continued Michel.

"What does that matter? Its bulk, compared with that of our projectile, was enormous, and its attraction was sufficient to have an influence upon our direction."

"That influence must have been very slight," said Nicholl.

"Yes, Nicholl, but slight as it was," answered Barbicané, "upon a distance of 84,000 leagues it was enough to make us miss the moon!"

## CHAPTER X

### THE OBSERVERS OF THE MOON

BARBICANE had evidently found the only plausible reason for the deviation. However slight it had been, it had been sufficient. The audacious attempt had miscarried by a chance happening, and unless anything unexpected happened, the lunar disc could no longer be reached. Would they pass near enough to resolve certain problems in physics and geology until then unsolved? This was the only question that occupied the minds of these bold travellers. As to the fate the future held in store for them, they would not even think about it. Yet what was to become of them amidst these infinite solitudes when air failed them? A few more days and they would fall suffocated in this body wandering at hazard. But a few days were centuries to these intrepid men, and they devoted every moment to observing the moon they no longer hoped to reach.

The distance which then separated the projectile from the satellite was estimated at about 200 leagues. Under these conditions the travellers were farther from the moon than are the inhabitants of the earth with their powerful telescopes.

It is, in fact, known that the instrument set up by Lord Rosse at Parsonstown, which magnifies 6,500 times, brings the moon to within sixteen leagues; and the powerful telescope set up at Long's Peak magnifies 48,000 times, and brings the moon to within less than two leagues, so that objects twelve yards in diameter were sufficiently distinct.

Thus, then, at that distance the surface details of the moon, seen without a telescope, were not distinctly determined. The eye caught the outline of those vast depressions inappropriately called "seas," but they could not determine



their nature. The prominence of the mountains disappeared under the splendid irradiation produced by the reflection of the solar rays. The eye, dazzled as if leaning over a furnace of molten silver, turned from it involuntarily.

However, the oblong form of the orb was already clearly seen.

It appeared like a gigantic egg, with the small end turned towards the earth. The moon, liquid and pliable in the first days of her formation, was originally a perfect sphere. But soon, drawn within the pale of the earth's gravitation, she became elongated under its influence. By becoming a satellite she lost her native purity of form; her centre of gravity was in advance of the centre of her figure, and from this fact some scientists draw the conclusion that air and water might be on the opposite side of the moon, which is never seen from the earth.

This alteration in the primitive forms of the satellite was visible for a few moments. The distance between the projectile and the moon diminished visibly; its velocity was considerably less than its initial velocity, but eight or nine times greater than that of our express trains. The oblique direction of the projectile, from its very obliquity, left Michel Ardan some hope of touching the lunar disc at some point or other. He could not believe that he should not get to it. No, he could not believe it, and this he often repeated. But Barbicane, who was a better judge, always answered him with pitiless logic.

"No, Michel, no. We can only reach the moon by a fall, and we are not falling. The centripetal force keeps us under the moon's influence, but the centrifugal force sends us irresistibly away from it."

This was said in a tone that deprived Michel Ardan of his last hopes.

At midnight the moon was full. At that precise moment the travellers ought to have set foot upon her if the unlucky asteroid had not made them deviate from their direction. The orb was exactly in the condition rigorously determined

by the Cambridge Observatory. She was mathematically at her perigee, and at the zenith of the twenty-eighth parallel. An observer placed at the bottom of the enormous Columbiad while it is pointed perpendicularly at the horizon would have framed the moon in the mouth of the cannon. A straight line drawn through the axis of the piece would have passed through the centre of the moon.

It need hardly be stated that during the night between the 5th and 6th of December the travellers did not take a minute's rest. Could they have closed their eyes so near to a new world? No. All their feelings were concentrated in one thought—to see! Representatives of the earth, of humanity past and present, all concentrated in themselves, it was through their eyes that the human race looked at these lunar regions and penetrated the secrets of its satellite! A strange emotion filled their hearts, and they went silently from one window to another.

Their observations were noted down by Barbicane, and were made rigorously exact. To make them they had telescopes. To control them they had maps.

The first observer of the moon was Galileo. His poor telescope only magnified thirty times. Nevertheless, in the spots that pitted the lunar disc "like eyes in a peacock's tail," he was the first to recognize mountains, and measure some heights to which he attributed, exaggerating, an elevation equal to the 20th of the diameter of the disc, or 8,000 metres. Galileo drew up no map of his observations.

A few years later an astronomer of Dantzic, Hevelius—by operations which were only exact twice a month, at the first and second quadrature—reduced Galileo's heights to one-twenty-sixth only of the lunar diameter. This was an exaggeration the other way. But it is to this man that the first map of the moon is due. The light round spots there form circular mountains, and the dark spots indicate vast seas which, in reality, are plains. To these mountains and extents of sea he gave terrestrial names. There is a Sinai in the middle of an Arabia, Etna in the centre of Sicily, the

Alps, Apennines, Carpathians, the Mediterranean, the Black Sea, the Caspian, etc.—names badly applied, for neither mountains nor seas recalled the shapes of their namesakes on the globe. That large white spot, joined on the south to vaster continents and terminated in a point, could hardly be recognized as the inverted image of the Indian Peninsula, the Bay of Bengal, and Cochin-China. So these names were not kept. Another cartographer, knowing human nature better, proposed a fresh nomenclature, which human vanity made haste to adopt.

This observer was Father Riccioli, a contemporary of Hevelius. He drew up a rough map full of errors. But he gave to the lunar mountains the names of great men of antiquity and *savants* of his own epoch.

A third map of the moon was executed in the seventeenth century by Dominique Cassini; superior to that of Riccioli in the execution, it is inexact in the measurements. Several smaller copies were published, but the plate long kept in the *Imprimerie Nationale* was sold by weight as old brass.

La Hire, a celebrated mathematician and designer, drew up a map of the moon four and a half yards high, which was never engraved.

After him, a German astronomer, Tobie Marger, about the middle of the eighteenth century, began the publication of a magnificent map, according to lunar measures, which he rigorously verified; but his death, which took place in 1762, prevented the completion of this beautiful work.

It was in 1830 that Messrs. Bœer and Moedler composed their celebrated *Mappa Selenographica*, according to an orthographical projection. This map reproduces the exact lunar disc, such as it appears, only the configurations of the mountains and plains are only correct in the central part; everywhere else—in the northern or southern portions, eastern or western—the configurations foreshortened cannot be compared with those of the centre. This map, one yard high and divided into four parts, is a masterpiece of lunar cartography.

After these may be cited the selenographic reliefs of the German astronomer Julius Schmidt, the topographical works of Father Secchi, the magnificent sheets of the English amateur, Waren de la Rue, and lastly a map on orthographical projection of Messrs. Lecouturier and Chapuis, a fine model set up in 1860, of very correct design and clear outlines.

Such is the nomenclature of the different maps relating to the lunar world. Barbicane possessed two, that of Messrs. Bœer and Moedler and that of Messrs. Chapuis and Lecouturier. They were to make his work of observer easier.

They had excellent marine glasses specially constructed for this journey. They magnified objects a hundred times; they would, therefore, have reduced the distance between the earth and the moon to less than 1,000 leagues. But then at a distance which towards 3 a.m. did not exceed a hundred miles, and in a medium which no atmosphere obstructed, these instruments brought the lunar level to less than fifteen hundred metres.



## CHAPTER XI

### IMAGINATION AND REALITY

"HAVE you ever seen the moon?" a professor asked one of his pupils ironically.

"No, sir," answered the pupil more ironically still, "but I have heard it spoken of."

In one sense the answer of the pupil might have been made by the immense majority of beings. How many people there are who have heard the moon spoken of and have never seen it—at least through a telescope! How many even have never examined the map of their satellite!

Looking at a comprehensive map of the moon, one peculiarity strikes us at once. In contrast to the geographical arrangements of the earth and Mars, the continents occupy the more southern hemisphere of the lunar globe. These continents have not such clear and regular boundary-lines as those of South America, Africa, and the Indian Peninsula. Their angular, capricious, and deeply-indented coasts are rich in gulfs and peninsulas. They recall the confusion in the islands of the Sound, where the earth is excessively cut up. If navigation has ever existed upon the surface of the moon it must have been exceedingly difficult and dangerous, and the Selenite mariners and hydrographers were greatly to be pitied, the former when they came upon these perilous coasts, the latter when they were marine surveying on the stormy banks.

It may also be noticed that upon the moon the South Pole is much more continental than the North Pole. On the latter there is only a slight strip of land capping it, separated from the other continents by vast seas. (When the word "seas" is used the vast plains probably covered by the sea formerly must be understood.) On the south the land covers

nearly the whole hemisphere. It is, therefore, possible that the Selenites have already planted their flag on one of their poles, whilst Franklin, Ross, Kane, Dumont d'Urville, and Lambert have been unable to reach this unknown point on the terrestrial globe.

Islands are numerous on the surface of the moon. They are almost all oblong or circular, as though traced with a compass, and seem to form a vast archipelago, like that charming group lying between Greece and Asia Minor. Involuntarily the names of Naxos, Tenedos, Milo, and Carpathos come into the mind, and you seek the ship of Ulysses or the "clipper" of the Argonauts. That was what it appeared to Michel Ardan; it was a Grecian Archipelago that he saw on the map. In the eyes of his less imaginative companions the aspect of these shores recalled rather the cut-up lands of New Brunswick and Nova Scotia; and where the Frenchman looked for traces of the heroes of fable, these Americans were noting favourable points for the establishment of mercantile houses in the interest of lunar commerce and industry.

The moon is like an immense Switzerland—a continual Norway, where volcanic influence has done everything. This surface, so profoundly rugged, is the result of the successive contractions of the crust while the orb was being formed. The lunar disc is excellent for the study of great geological phenomena. According to the remarks of some astronomers, its surface, although more ancient than the surface of the earth, has remained newer. On it there is no water to deteriorate the primitive relief, the continuous action of which produces a sort of general levelling. No air, the decomposing influence of which modifies orographical profiles. There Pluto's work unaltered by Neptune's, is in all its native purity. It is the earth as she was before tides and currents covered her with layers of soil.

After having wandered over these vast continents the eye is attracted by still vaster seas. Not only does their formation, situation, and aspect recall the terrestrial oceans, but,

as upon earth, these seas occupy the largest part of the globe. And yet these are not liquid tracts, but plains, the nature of which the travellers hoped soon to determine.

Astronomers have decorated these pretended seas with at least odd names which science has respected at present. Michel Ardan was right when he compared this map to a "map of tenderness," drawn up by Scudery or Cyrano de Bergerac.

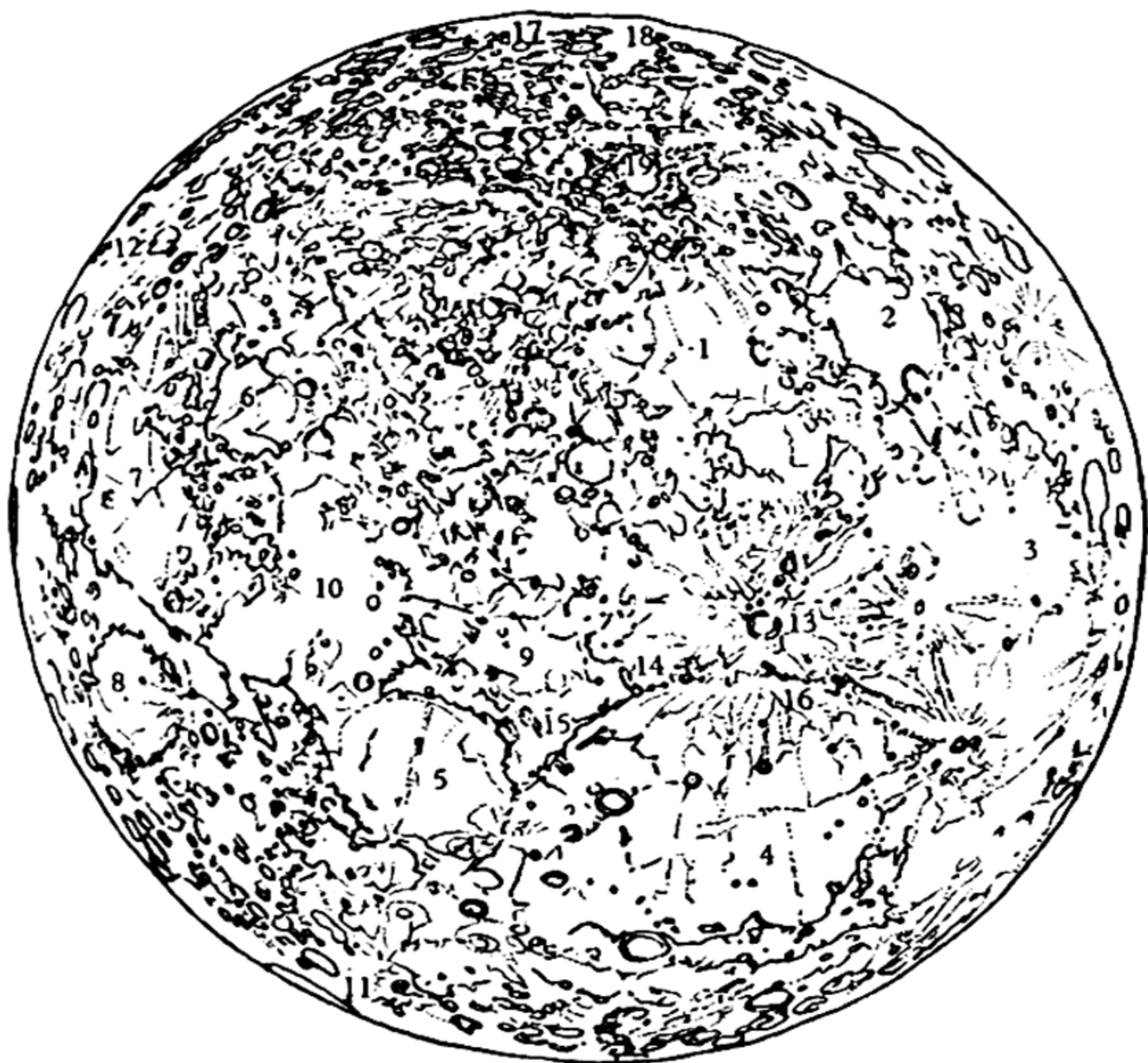
"Only," added he, "it is no longer the map of sentiment like that of the eighteenth century; it is the map of life, clearly divided into two parts, the one feminine, the other masculine. To the women, the right hemisphere; to the men, the left!"

When he spoke thus Michel made his companions shrug their shoulders. Barbicane and Nicholl looked at the lunar map from another point of view to that of their imaginative friend. However, their imaginative friend had some reason on his side. Judge if he had not.

In the left hemisphere stretches the "Sea of Clouds," where human reason is so often drowned. Not far off appears the "Sea of Rains," fed by all the worries of existence. Near lies the "Sea of Tempests," where man struggles incessantly against his too-often victorious passions. Then, exhausted by deceptions, treasons, infidelities, and all the procession of terrestrial miseries, what does he find at the end of his career? The vast "Sea of Humours," scarcely softened by some drops from the waters of the "Gulf of Dew!" Clouds, rain, tempests, humours, does the life of man contain aught but these? and is it not summed up in these four words?

The right-hand hemisphere dedicated to "the women" contains smaller seas, the significant names of which agree with every incident of feminine existence. There is the "Sea of Serenity," over which bends the young maiden, and the "Lake of Dreams," which reflects her back a happy future. The "Sea of Nectar," with its waves of tenderness and breezes of love! The "Sea of Fecundity," the "Sea of





Some of the main places mentioned in the story. 1, Sea of Clouds; 2, Sea of Humours; 3, Sea of Tempests; 4, Sea of Rains; 5, Sea of Serenity; 6, Sea of Nectar; 7, Sea of Fecundity; 8, Sea of Crises; 9, Sea of Vapours; 10, Sea of Tranquillity; 11, Sea of Humboldt; 12, Southern Sea; 13, Copernicus; 14, Eratosthenes; 15, Apennines; 16, Carpathians; 17, Mt. Leibnitz; 18, Mt. Dætfel; 19, Tycho. Note that "north" is at the bottom of the map. Moon maps are often drawn in this manner as the telescope inverts the object it is focused on.



Crises," and the "Sea of Vapours," the dimensions of which are, perhaps, too restricted, and lastly, that vast "Sea of Tranquillity" where all false passions, all useless dreams, all unassuaged desires are absorbed, and the waves of which flow peacefully into the "Lake of Death!"

What a strange succession of names! What an odd division of these two hemispheres of the moon, united to one another like man and woman, and forming a sphere of life, carried through space. And was not the imaginative Michel right in thus interpreting the fancies of the old astronomers?

But whilst his imagination ran riot on the "seas," his grave companions were looking at other things. They were learning this new world by heart. They were measuring its angles and diameters.

To Barbicane and Nicholl the "Sea of Clouds" was an immense depression of ground, with circular mountains scattered about on it; covering a great part of the western side of the southern hemisphere, it covered 184,800 square leagues, and its centre was in south latitude  $15^{\circ}$ , and west longitude  $20^{\circ}$ . The Ocean of Tempests, *Oceanus Procellarum*, the largest plain on the lunar disc, covered a surface of 328,300 square leagues, its centre being in north latitude  $10^{\circ}$ , and east longitude  $45^{\circ}$ . From its bosom emerge the admirable shining mountains of Kepler and Aristarchus.

More to the north, and separated from the Sea of Clouds by high chains of mountains, extends the Sea of Rains, *Mare Imbrium*, having its central point in north latitude  $35^{\circ}$  and east longitude  $20^{\circ}$ ; it is of a nearly circular form, and covers a space of 193,000 leagues. Not far distant the Sea of Humours, *Mare Humorum*, a little basin of 44,200 square leagues only, was situated in south latitude  $25^{\circ}$ , and east longitude  $40^{\circ}$ . Lastly, three gulfs lie on the coast of this hemisphere—the Torrid Gulf, the Gulf of Dew, and the Gulf of Iris, little plains enclosed by high chains of mountains.

The "Feminine" hemisphere, naturally more capricious,

was distinguished by smaller and more numerous seas. These were, towards the north, the *Mare Frigoris*, in north latitude  $55^{\circ}$  and longitude  $0^{\circ}$ , with 76,000 square leagues of surface, which joined the Lake of Death and Lake of Dreams; the Sea of Serenity, *Mare Serenitatis*, by north latitude  $25^{\circ}$  and west longitude  $20^{\circ}$ , comprising a surface of 80,000 square leagues; the Sea of Crises, *Mare Crisium*, round and very compact, in north latitude  $17^{\circ}$  and west longitude  $55^{\circ}$ , a surface of 40,000 square miles, a veritable Caspian buried in a girdle of mountains. Then on the equator, in north latitude  $5^{\circ}$  and west longitude  $25^{\circ}$ , appeared the Sea of Tranquillity, *Mare Tranquillitatis*, occupying 121,509 square leagues of surface; this sea communicated on the south with the Sea of Nectar, *Mare Nectaris*, an extent of 28,800 square leagues, in south latitude  $15^{\circ}$  and west longitude  $35^{\circ}$ , and on the east with the Sea of Fecundity, *Mare Fecunditatis*, the vastest in this hemisphere, occupying 219,300 square leagues, in south latitude  $3^{\circ}$  and west longitude  $50^{\circ}$ . Lastly, quite to the north and quite to the south lie two more seas, the Sea of Humboldt, *Mare Humboldtianum*, with a surface of 6,500 square leagues, and the Southern Sea, *Mare Australe*, with a surface of 26,000.

In the centre of the lunar disc, across the equator and on the zero meridian, lies the centre gulf, *Sinus Medii*, a sort of hyphen between the two hemispheres.

Thus appeared to the eyes of Nicholl and Barbicane the surface always visible of the earth's satellite. When they added up these different figures they found that the surface of this hemisphere measured 4,738,160 square leagues, 3,317,600 of which go for volcanoes, chains of mountains, amphitheatres, islands—in a word, all that seems to form the solid portion of the globe—and 1,410,400 leagues for the seas, lake, marshes, and all that seems to form the liquid portion, all of which was perfectly indifferent to the worthy Michel.

It will be noticed that this hemisphere is thirteen and a

half times smaller than the terrestrial hemisphere. And yet already 50,000 craters have been counted. It is a rugged surface worthy of the unpoetical qualification of "green cheese" which the English have given it.

When Barbicane pronounced this disobliging name Michel Ardan gave a bound.

"That is how the Anglo-Saxons of the nineteenth century treat the beautiful Diana, the blonde Phœbe, the amiable Isis, the charming Astarte, the Queen of Night, the daughter of Latona and Jupiter, the younger sister of the radiant Apollo!"

## CHAPTER XII

### LUNAR MOUNTAINS

It has already been pointed out that the direction followed by the projectile was taking us towards the northern hemisphere of the moon. The travellers were far from that central point which they ought to have touched if their craft had not been deviated from its course.

It was half-past twelve at night. Barbicane then estimated his distance at 1,400 kilometres, a distance rather greater than the length of the moon's radius, and which must diminish as he drew nearer the North Pole. The projectile was then not at the altitude of the equator, but on the tenth parallel, and from that latitude carefully observed on the map as far as the Pole, Barbicane and his two companions were able to watch the moon under the most favourable circumstances.

In fact, by using telescopes, this distance of 1,400 kilometres was reduced to fourteen miles, or four and a half leagues. The telescope of the Rocky Mountains brought the moon still nearer, but the terrestrial atmosphere singularly lessened its optical power. Thus Barbicane, in his projectile, by looking through his glass, could already see certain details almost imperceptible to observers on the earth.

"My friends," then said the president in a grave voice, "I do not know where we are going, nor whether we shall ever see the earth again. Nevertheless, let us do our work as if one day it will be used. We are astronomers. This craft is the Cambridge Observatory transported into space. Let us make our observations."

That said, the work was begun with extreme precision, and it faithfully reproduced the different aspects of the



moon at the variable distances which the projectile reached in relation to that orb.

Whilst the projectile was at the altitude of the 10th north parallel it seemed to follow the 20th degree of east longitude.

Here may be made an important remark on the subject of the map which they used for their observations. In the selenographic maps, where, on account of the reversal of objects by the telescope, the south is at the top and the north at the bottom, it seems natural that the east should be on the left and the west on the right. However, it is not so. If the map were turned upside down, and showed the moon as she appears, the east would be left and the west right, the inverse of the terrestrial maps. The reason for this anomaly is the following:—Observers situated in the northern hemisphere—in Europe, for example—perceive the moon in the south from them. When they look at her they turn their backs to the north, the opposite position they take when looking at a terrestrial map. Their backs being turned to the north, they have the east to the left and the west to the right. For observers in the southern hemisphere—in Patagonia, for example—the west of the moon would be on their left and the east on their right, for the south would be behind them.

Such is the reason for the apparent reversal of these two cardinal points, and this must be remembered whilst following the observations of President Barbicane.

Helped by the *Mappa Selenographica* of Bœer and Moedler, the travellers could, without hesitating, survey that portion of the disc in the field of their telescopes.

“What are we looking at now?” asked Michel.

“At the northern portion of the Sea of Clouds,” answered Barbicane. “We are too far off to make out its nature. Are those plains composed of dry sand, as the first astronomers believed? Or are they only immense forests, according to the opinion of Mr. Waren de la Rue, who grants a very low but very dense atmosphere to the moon? We shall find that out later on. We will affirm nothing till we are quite certain.”

This Sea of Clouds is rather doubtfully traced upon the maps. It is supposed that this vast plain is strewn with blocks of lava vomited by the neighbouring volcanoes on its right side, Ptolemy, Purbach, and Arzachel. The projectile was drawing nearer, and the summits which close in this sea on the north were distinctly visible. In front rose a mountain shining gloriously, the top of which seemed drowned in the solar rays.

"That mountain is——?" asked Michel.

"Copernicus," answered Barbicane.

Copernicus forms the most important radiating system in the southern hemisphere, according to Tycho Brahé. It rises isolated like a gigantic lighthouse over that of the Sea of Clouds bordering on the Sea of Tempests, and it lights two oceans at once with its splendid rays. Those long luminous trails, so dazzling at full moon, made a magnificent spectacle; they pass the boundary chains on the north, and stretch as far as the Sea of Rains. At 1 a.m., terrestrial time, the projectile, like a balloon carried into space, hung over this superb mountain.

Copernicus is only an extinct volcano, like those on that side of the moon. It has a diameter of about twenty-two leagues. The glasses showed traces of stratifications in it produced by successive eruptions, and its neighbourhood appeared strewn with volcanic remains, which were still seen in the crater.

"There exist," said Barbicane, "several sorts of amphitheatres on the surface of the moon, and it is easy to see that Copernicus belongs to the radiating class. If we were nearer we should perceive the cones which bristle in the interior, and which were formerly so many fiery mouths."

"How splendidly it shines!" said Michel. "I think it would be difficult to see a more beautiful spectacle!"

"What should you say, then," answered Barbicane, "if the chances of our journey should take us towards the southern hemisphere?"

"Well, I should say it is finer still," replied Michel Ardan.

At that moment the projectile hung right over the amphitheatre. The circumference of Copernicus formed an almost perfect circle, and its steep ramparts were clearly defined. A second circular enclosure could even be distinguished. A grey, wild plain spread around on which every relief appeared yellow. At the bottom of the amphitheatre, as if in a jewel-case, sparkled for one instant two or three eruptive cones like enormous dazzling gems. Towards the north the sides of the crater were lowered into a depression which would probably have given access to the interior of the crater.

As they passed above the surrounding plain Barbicane was able to note a large number of mountains of slight importance, amongst others a little circular mountain called "Gay-Lussac," more than twenty-three kilometres wide. Towards the south the plain was very flat, without one elevation or projection of the soil. Towards the north, on the contrary, as far as the place where it borders on the Ocean of Tempests, it was like a liquid surface agitated by a storm, of which the hills and hollows formed a succession of waves suddenly frozen. Over the whole of this, and in all directions, ran the luminous trails which converged to the summit of Copernicus. Some had a width of thirty kilometres over a length that could not be estimated.

The travellers discussed the origin of these strange rays, but they could not determine their nature any better than terrestrial observers.

"Why," said Nicholl, "may not these rays be simply the spurs of the mountains reflecting the light of the sun more vividly?"

"No," answered Barbicane, "if it were so in certain conditions of the moon they would throw shadows, which they do not."

In fact, these rays only appear when the sun is in opposition with the moon, and they disappear as soon as its rays become oblique.

"But what explanation of these trails of light have been



imagined?" asked Michel, "for I cannot believe that experts would ever stop short for want of explanation."

"Yes," answered Barbicane, "Herschel has given a theory but he does not affirm it."

"Never mind; what is his theory?"

"He thought that these rays must be streams of cold lava which shone when the sun struck them normally."

"That may be true, but nothing is less certain. However, if we pass nearer to Tycho we shall be in a better position to find out the cause of this radiation."

"What do you think that plain is like, seen from the height we are at?" asked Michel.

"I don't know," answered Nicholl.

"Well, with all these pieces of lava, sharpened like spindles, it looks like 'an immense game of spilikins,' thrown down pell-mell. We only want a hook to draw them up."

"Be serious for once in your life," said Barbicane.

"I will be serious," replied Michel tranquilly, "and instead of spilikins let us say they are bones. This plain would then be only an immense cemetery upon which would rest the immortal remains of a thousand generations. Do you like that comparison better?"

"One is as good as the other," answered Barbicane.

"The devil! You are difficult to please," replied Michel.

"My worthy friend," resumed the prosaic Barbicane, "it does not matter what it looks like when we don't know what it is."

"A good answer," exclaimed Michel; "that will teach me to argue with experts."

In the meantime the projectile went with almost uniform speed round the lunar disc. A fresh landscape lay before their eyes every instant. About half-past one in the morning they caught a glimpse of the summit of another mountain. Barbicane consulted his map, and recognized Eratosthenes.

It was a circular mountain 4,500 metres high, one of those amphitheatres so numerous upon the satellite. Barbicane informed his friends of Kepler's opinion upon the formation



of these circles. According to the celebrated mathematician, these cavities had been dug out by the hand of man.

"What for?" asked Nicholl.

"In order to preserve themselves from the ardour of the solar rays, which strike the moon during fifteen consecutive days."

"The Selenites were not fools!" said Michel.

"It was a singular idea!" answered Nicholl. "But it is probable that Kepler did not know the real dimensions of these circles, for digging them would have been giant's labour, impracticable for Selenites."

"Why so, if the weight on the surface of the moon is six times less than upon the surface of the earth?" said Michel.

"But if the Selenites are six times smaller?" replied Nicholl.

"And if there are no Selenites?" added Barbicane, which terminated the discussion.

Eratosthenes soon disappeared from the horizon without the projectile having been sufficiently near it to allow a rigorous observation. This mountain separated the Apennines from the Carpathians.

On the moon several chains of mountains have been distinguished which are principally distributed over the northern hemisphere. Some, however, occupy certain portions of the southern hemisphere.

The most important of these chains is the Apennines, the development of which extends 150 leagues, and is yet inferior to that of the great orographical movements of the earth. The Apennines run along the eastern border of the Sea of Rains, and are continued on the north by the Carpathians, the profile of which measures about 100 leagues.

The travellers could only catch a glimpse of the summit of these Apennines which lie between west long.  $10^{\circ}$  and east long.  $16^{\circ}$ ; but the chain of the Carpathians was visible from  $18^{\circ}$  to  $30^{\circ}$  east long., and they could see how they were distributed.

One theory seemed to them very justifiable. Seeing that this chain of the Carpathians was here and there circular in form and with high peaks, they concluded that it once formed important amphitheatres. These mountainous circles must have been broken up by the vast cataclysm to which the Sea of Rains was subjected. These Carpathians looked then what the amphitheatres of Purbach, Arzachel, and Ptolemy would if some cataclysm were to throw down their left ramparts and transform them into continuous chains. They present an average height of 3,200 metres, a height comparable to certain of the Pyrenees. Their southern slopes fall straight into the immense Sea of Rains.

About 2 a.m. the distance from the projectile to the moon was only 1,200 kilometres, brought by means of telescopes to two and a half leagues.

The "Mare Imbrium" lay before the eyes of the travellers like an immense depression of which the details were not very distinct. Near them on the left rose Mount Lambert, the altitude of which is estimated at 1,813 metres, and farther on, upon the borders of the Ocean of Tempests, in north lat.  $23^{\circ}$  and east long.  $29^{\circ}$ , rose the shining mountain of Euler. This mountain rises only 1,815 metres above the lunar surface.

## CHAPTER XIII

### LUNAR LANDSCAPES

AT half-past two in the morning the craft was over the 30th lunar parallel at an effective distance of 1,000 kilometres, reduced by the optical instruments to ten. The following is an exact description of what Barbicane and his companions saw from that height:

Large patches of different colours appeared on the disc. Students of the moon do not agree about their nature. They are quite distinct from each other. Julius Schmidt is of the opinion that if the earth's oceans were dried up, a Selenite observer could only tell the difference between the earth's oceans and plains by patches of colour as distinctly varied as those being observed upon the moon. According to him, the colour common to the vast plains, known under the name of "seas," is dark grey, mixed with green and brown. Some of the large craters are coloured in the same way.

Barbicane knew this opinion. He noticed that they were right, whilst certain astronomers, who only allow grey colouring on the surface of the moon, are wrong. In certain places the green colour was very vivid; according to Julius Schmidt, it is so in the Seas of Serenity and Humours. Barbicane likewise remarked the wide craters with no interior cones, which are of a bluish colour, similar to that of fresh-polished sheets of steel. These colours really belonged to the lunar disc, and did not result, as certain astronomers think, either from some imperfection in the object-glasses of the telescopes or the earth's atmosphere. Barbicane had no longer any doubt about it. He was looking at it through the void, and could not commit any optical error. He considered that the existence of this different colouring was proved to science. Now, were the green shades

owing to tropical vegetation, kept up by a low and dense atmosphere? He could not yet be certain.

Farther on he noticed a reddish tinge, quite sufficiently distinct. A similar colour had already been observed upon the bottom of an isolated enclosure, known under the name of the Lichtenberg Amphitheatre, which is situated near the Hercynian Mountains, on the border of the moon. But he could not make out its nature.

He was not more fortunate about another peculiarity of the disc, for he could not find out its cause. The peculiarity was the following one:

Michel Ardan was watching near the president when he noticed some long white lines brilliantly lighted up by the direct rays of the sun. It was a succession of luminous furrows, very different from the radiation that Copernicus had presented. They ran in parallel lines.

Michel with his usual readiness, exclaimed—

“Why, there are cultivated fields!”

“Cultivated fields!” repeated Nicholl, shrugging his shoulders.

“Ploughed fields, at all events,” replied Michel Ardan. “But what ploughmen these Selenites must be, and what gigantic oxen they must harness to their ploughs, to make such furrows!”

“They are not furrows, they are crevices!”

“Crevices let them be,” answered Michel. “Only what do you mean by crevices in the world of science?” Barbicane soon told his companions all he knew about lunar crevices. He knew that they were furrows observed upon all the non-mountainous parts of the lunar disc; that these furrows, generally isolated, were from four to five leagues only; that their width varies from 1,000 to 1,500 metres, and their edges are strictly parallel. But he knew nothing more about their formation or their nature.

Barbicane watched these furrows through his telescope very attentively. He noticed that their banks were exceedingly steep. They were long parallel ramparts; with a



little imagination they might be taken for long lines of fortifications raised by Selenite engineers.

Some of these furrows were as straight as if they had been cut by line, others were slightly curved though with edges still parallel. Some crossed each other. Some crossed craters. Some furrowed the circular cavities, such as Posidonius or Petavius. Some crossed the seas, notably the Sea of Serenity.

These accidents of Nature had naturally exercised the imagination of terrestrial astronomers. The earliest observations did not discover these furrows. Neither Hevelius, Cassini, La Hire, nor Herschel seems to have known them. It was Schroeter who in 1789 first attracted the attention to them. At present there are seventy-six; but though they have been counted, their nature has not yet been determined. They are not fortifications certainly, any more than they are beds of dried-up rivers, for water so light on the surface of the moon could not have dug such ditches.

It must, however, be acknowledged that Michel Ardan had an idea, and that, without knowing it, he shared it with Julius Schmidt.

"Why," said he, "may not these inexplicable things be plants of some sort."

"In what way do you mean?" asked Barbicane.

"Now do not be angry, worthy president," answered Michel, "but may not these black lines be regular rows of trees?"

"Do you want to find some vegetation?" said Barbicane.

"I want to explain what you scientific men do not explain! My theory will at least explain why these furrows disappear, or seem to disappear, at regular epochs."

"Why should they?"

"Because trees might become invisible when they lose their leaves, and visible when they grow again."

"Your explanation is ingenious, old fellow," answered Barbicane, "but it cannot be admitted."

"Why?"

"Because there cannot be said to be any season on the

surface of the moon, and, consequently, there can be no seasonal growth."

The origin of these furrows is a difficult question to solve. They were certainly formed after the craters and amphitheatres, for several have crossed them, and broken their circular ramparts. It may be that they are contemporary with the latest geographical epochs, and are only owing to the expansion of natural forces.

In the meantime the projectile had reached the altitude of the 40th degree of lunar latitude at a distance that could not be greater than 800 kilometres. Objects appeared through the telescopes at two leagues only.

The terrestrial atmosphere ought to be 170 times more transparent than it is in order to allow astronomers to make observations on the surface of the moon. But in the void the projectile was moving in no obstruction lay between the eye of the observer and the object observed. What is more, Barbicane was at a less distance than the most powerful telescopes, even that of Lord Rosse or the one on the Rocky Mountains, could give. Everything was, therefore, favourable for solving the great question of the habitability of the moon. Yet the solution of this question escaped him still. He could only distinguish the deserted beds of the immense plains, and, towards the north, arid mountains. Nothing betrayed the hand of man. No ruin indicated his passage. No animals indicated that life was developed there, even in an inferior degree. There was no movement anywhere, no appearance of vegetation anywhere. Of the three kingdoms represented on the terrestrial globe, only one was represented on that of the moon—the mineral kingdom.

"So," said Michel Ardan, looking rather put out, "there is nobody after all."

"No," answered Nicholl; "we have seen neither man, animal, nor tree as yet. After all, if the atmosphere lay at the bottom of cavities, in the interior of the amphitheatres, or even on the opposite face of the moon, we cannot decide the question."

"It may be," added Barbicane, "that the Selenites can see our projectile, but we cannot see them."

About 11 a.m., at the altitude of the 50th parallel, the distance was reduced to 300 miles. On the left rose the capricious outlines of a chain of mountains, outlined in full light. Towards the right, on the contrary, was a large black hole like a vast dark and bottomless well bored in the lunar soil.

That hole was the Black Lake, or Pluto, a deep circle from which the moon could be conveniently studied between the last quarter and the new moon, when the shadows are thrown from west to east.

This black colour is rarely met with on the surface of the satellite. It has, as yet, only been seen in the depths of the circle of Endymion, to the east of the Cold Sea, in the northern hemisphere, and at the bottom of the circle of Grimaldi upon the equator towards the eastern border of the orb.

Pluto is a circular mountain, situated in north lat.  $51^{\circ}$  and east long.  $9^{\circ}$ . Its circle is fifty miles long and thirty wide. Barbicane regretted not passing directly over this vast opening. There was an abyss to see, perhaps some mysterious phenomenon to become acquainted with. But the course of the projectile could not be guided.

About 5 a.m. the northern limit of the Sea of Rains was at last passed. Mounts La Condamine and Fontenelle remained, the one on the left, the other on the right. That part of the disc, starting from the 60th degree, became absolutely mountainous. The telescopes brought it to within one league, an inferior distance to that between the summit of Mont Blanc and the sea-level. All this region was bristling with peaks and amphitheatres. Mount Philolaus rose about the 70th degree to a height of 3,700 metres, opening an elliptical crater sixteen leagues long and four wide.

Then the disc, seen from that distance, presented an exceedingly strange aspect. The landscapes were very different to earthly ones, and also very inferior.



The moon having no atmosphere presented some strange sights. There is no twilight on its surface, night following day and day following night with the suddenness of a lamp extinguished or lighted in profound darkness. There is no transition from cold to heat: the temperature falls in one instant from boiling-water heat to the cold of space.

Another consequence of this absence of air is the following: Absolute darkness reigns where the sun's rays do not penetrate. What is called diffused light upon the earth, the luminous matter that the air holds in suspension, which creates twilights and dawns, which produces shadows, penumbræ, and all the magic of the chiaroscuro, does not exist upon the moon. Hence the harshness of contrasts that only admit two colours, black and white. If a Selenite shades his eyes from the solar rays the sky appears absolutely dark, and the stars shine as in the darkest nights.

The impression produced on Barbicane and his two friends by this strange state of things may well be imagined. They did not know how to use their eyes. They could no longer seize the respective distances in perspective. A lunar landscape, which does not soften the phenomenon of the chiaroscuro, could not be painted by a landscape-painter of the earth. It would be nothing but blots of ink upon white paper.

This aspect of things did not alter even when the projectile, then at the altitude of the 80th degree, was only separated from the moon by a distance of fifty miles, not even when, at 5 a.m., it passed at less than twenty-five miles from the mountain of Gioja, a distance which the telescopes reduced to half-a-mile. It seemed as if they could have touched the moon. It appeared impossible that before long the projectile should not knock against it, if only at the North Pole, where the brilliant mountains were clearly outlined against the dark background of the sky. Michel Ardan wanted to open one of the port-lights and jump upon the lunar surface. What was a fall of twelve leagues? He thought nothing of that. It would, however, have been a useless attempt, for if



the projectile was not going to reach any point on the satellite, Michel would have been hurled along by its movement, and not have reached it either.

At that moment, 6 a.m., the lunar pole appeared. Only half the disc, brilliantly lighted, appeared to the travellers, whilst the other half disappeared in the darkness. The projectile suddenly passed the line of demarcation between intense light and absolute darkness, and was suddenly plunged into the profoundest night.

## CHAPTER XIV

### A NIGHT OF THREE HUNDRED AND FIFTY-FOUR HOURS AND A HALF

AT the moment this took place the projectile was grazing the moon's North Pole, at less than twenty-five miles' distance. A few seconds had, therefore, sufficed to plunge it into the absolute darkness of space. The transition had taken place so rapidly, without gradations of light, that the orb seemed to have been blown out by a powerful gust.

"The moon has melted, disappeared!" cried Michel Ardan, wonder-stricken.

In fact, no ray of light or shade had appeared on the disc, formerly so brilliant. The obscurity was complete, and rendered deeper still by the shining of the stars. It was the darkness of lunar night, which lasts  $354\frac{1}{2}$  hours on each point of the disc—a long night, the result of the equality of the movements of translation and rotation of the moon, the one upon herself, the other round the earth. The projectile in the satellite's cone of shadow was no longer under the action of the solar rays.

In the interior darkness was, therefore, complete. The travellers could no longer see one another. However desirous Barbicane might be to economize the gas, of which he had so small a reserve, he was obliged to use artificial light—an expensive brilliancy which the sun then refused.

"The devil take the radiant orb!" cried Michel Ardan; "he is going to force us to spend our gas instead of giving us his light for nothing."

"We must not accuse the sun," said Nicholl. "It is not his fault, it is the moon's fault for coming and putting herself like a screen between us and him."

"It's the sun!" said Michel again.

"It's the moon!" retorted Nicholl.

An idle dispute began, which Barbicane put an end to by saying—

"My friends, it is neither the fault of the sun nor the moon. It is the projectile's fault for deviating from its course instead of rigorously following it. Or, to be juster still, it is the fault of that unfortunate asteroid which altered our first direction."

"Good!" answered Michel Ardan; "as that business is settled let us have our breakfast. After a night entirely passed in making observations, we want something to set us to rights a little."

This proposition met with no opposition. Michel prepared the meal in a few minutes. But they ate for the sake of eating. They drank without toasts or hurrahs. The bold travellers, borne away into the darkness of space without their accustomed escort of rays, felt a vague uneasiness invade their hearts. The "farouche" darkness, so dear to the pen of Victor Hugo, surrounded them on all sides.

In the meantime they talked about this interminable night, 354½ hours, or nearly 15 days, long, which physical laws have imposed upon the inhabitants of the moon. Barbicane gave his friends some explanation of the causes and consequences of this curious phenomenon.

"Curious it certainly is," said he, "for if each hemisphere of the moon is deprived of solar light for fifteen days, the one over which we are moving at this moment does not even enjoy, during its long night, a sight of the brilliantly-lighted earth. In a word, there is no moon, applying that qualification to our spheroid, except for one side of the disc. Now, if it were the same upon earth—if, for example, Europe never saw the moon, and she was only visible at the antipodes—you can figure for yourselves the astonishment of a European on arriving in Australia."

"They would make the voyage just to go and see the moon," answered Michel.

"Well," resumed Barbicane, "that astonishment is

reserved for the Selenite who inhabits the opposite side of the moon to the earth, a side for ever invisible to our fellow-beings on earth."

"And which we should have seen," added Nicholl, "if we had arrived here when the moon is new—that is to say, a fortnight later."

"To make amends," resumed Barbicane, "an inhabitant of the visible face is favoured by Nature, to the detriment of the inhabitant on the invisible face. The latter, as you see, has dark nights of 354½ hours long. The other, on the contrary, when the sun, which has lighted him for a fortnight, sets under the horizon, sees on the opposite horizon a splendid orb rise. It is the earth, thirteen times larger than that moon which we know—the earth, which only disappears when the sun reappears."

"A fine sentence," said Michel Ardan; "rather academical perhaps."

"It follows," resumed Barbicane, nowise put out, "that the visible face of the disc must be very agreeable to inhabit, as it is always lighted by the sun or the earth."

"But," said Nicholl, "this advantage must be quite compensated by the unbearable heat which this light must cause."

"This inconvenience is the same under two faces, for the light reflected by the earth is evidently deprived of heat. However, this invisible face is still more deprived of heat than the visible face. I say that for you, Nicholl; Michel would probably not understand."

"Thank you," said Michel.

"In fact," resumed Barbicane, "when the invisible face receives the solar light and heat the moon is new—that is to say, that she is in conjunction, that she is situated between the sun and the earth. She is then, on account of the situation which she occupies in opposition when she is full, nearer the sun by the double of her distance from the earth. Now this distance may be estimated at the two-hundredth part of that which separates the sun and the earth; or, in round numbers, at two hundred thousand leagues. Therefore



this visible face is nearer the sun by two hundred thousand leagues when it receives his rays."

"Quite right," replied Nicholl.

"Whilst——" resumed Barbicane.

"Allow me," said Michel, interrupting his grave companion.

"What do you want?"

"I want to go on with the explanation."

"Why?"

"To prove that I have understood."

"Go on, then," said Barbicane, smiling.

"Whilst," said Michel, imitating the tone and gestures of President Barbicane, "when the visible face of the moon is lighted by the sun the moon is full—that is to say, situated with regard to the earth the opposite to the sun. The distance which separates it from the radiant orb is then increased in round numbers by 200,000 leagues, and the heat which it receives must be rather less."

"Well done!" exclaimed Barbicane. "Do you know, Michel, for an artist you are intelligent."

"Yes," answered Michel carelessly, "we are all intelligent on the Boulevard des Italiens."

Barbicane shook hands gravely with his amiable companion, and went on to detail other advantages of an inhabitant on the moon's visible face.

Amongst others he quoted the observations of the sun's eclipses, which can only be seen from one side of the lunar disc, because the moon must be in opposition before they can take place. These eclipses, caused by the earth being between the sun and the moon, may last two hours, during which, on account of the rays refracted by its atmosphere, the terrestrial globe can only appear like a black spot upon the sun.

"Then," said Nicholl, "the invisible part is very ill-treated by Nature."

"No matter," answered Michel; "if we ever become Selenites, we will inhabit the visible face. I like light."

"Unless," replied Nicholl, "the atmosphere should be condensed on the other side, as certain astronomers pretend."

"That is a consideration," answered Michel simply.

In the meantime breakfast was finished, and the observers resumed their posts. They tried to see through the dark port-light by putting out all light in the projectile. But not one luminous atom penetrated the blackness.

One inexplicable fact preoccupied Barbicane. How was it that though the projectile had been so near the moon, within a distance of twenty-five miles, it had not fallen upon her? If its speed had been enormous, he would have understood why. But with a relatively slight speed the resistance to lunar attraction could not be explained. Was the projectile under the influence of some strange force? Did some body maintain it in the ether? It was evident that it would not touch any point upon the moon. Where was it going? Was it going farther away from or nearer to the disc? Was it carried along in the gloom across infinitude? How were they to know, how calculate in the dark? All these questions made Barbicane anxious, but he could not solve them.

In fact, the invisible orb was there, perhaps, at a distance of some leagues only, but neither his companions nor he could any longer see it. If any noise were made on its surface they could not hear it. The air was wanting to transmit to them the groans of that moon which the Arabian legends make "a man already half-granite, but still palpitating."

It will be agreed that it was enough to exasperate the most patient observers. It was precisely the unknown hemisphere that was hidden from their eyes. That face which a fortnight sooner or a fortnight later had been, or would be, splendidly lighted up by the solar rays, was lost in absolute darkness. Where would the projectile be in another fortnight? Where would the hazards of attraction have taken it? Who could say?

It is generally admitted that the invisible hemisphere of

the moon is absolutely similar to the visible hemisphere. One-seventh of it is seen in those movements of libration Barbicane spoke of. Now upon the surface seen there were only plains and mountains, amphitheatres and craters, like those on the maps. They could there imagine the same arid and dead nature. And yet, supposing the atmosphere to have taken refuge upon that face? Suppose that with the air water had given rise to life? Suppose that vegetation still persists there? Suppose that animals people these continents and seas? Suppose that man still lives under those conditions? How many questions there were it would have been interesting to solve! What solutions might have been drawn from the contemplation of that hemisphere! What delight it would have been to glance at that world which no human eye has seen!

The disappointment of the travellers in the midst of this darkness may be imagined. All observation of the lunar disc was prevented. The constellations alone were visible, and it must be said that no astronomers had ever been in such favourable conditions to observe them.

In fact, nothing could equal the splendour of this starry world, bathed in limpid ether. Diamonds set in the celestial vault threw out superb flames. One look could take in the firmament from the Southern Cross to the North Star, those two constellations which will in 12,000 years, on account of the succession of equinoxes, resign their *rôles* of polar stars, the one to Canopus in the southern hemisphere, the other to Wega in the northern. Imagination lost itself in this sublime infinitude, amidst which the projectile was moving like a new star created by the hand of man. From natural causes these constellations shone with a soft lustre; they did not twinkle because there was no atmosphere to intervene with its strata unequally dense, and of different degrees of humidity, which causes this scintillation.

The travellers long watched the firmaments, upon which the vast screen of the moon made an enormous black hole. But a painful sensation drew them from their contemplation.



This was an intense cold, which soon covered the glasses of the port-lights with a thick coating of ice. The sun no longer warmed the projectile with his rays, and it gradually lost the heat stored up in its walls. This heat was by radiation rapidly evaporated into space, and a considerable lowering of the temperature was the result. The interior humidity was changed into ice by contact with the window-panes, and prevented all observation.

Nicholl, consulting the thermometer, said that it had fallen to  $17^{\circ}$  (Centigrade) below zero ( $1^{\circ}$  Fahr.). Therefore, notwithstanding every reason for being economical, Barbicane was obliged to seek heat as well as light from gas. The low temperature of the cabin was no longer bearable. Its occupants would have been frozen to death.

"We will not complain about the monotony of the journey," said Michel Ardan. "What variety we have had, in temperature at all events! At times we have been blinded with light, and saturated with heat like the Indians of the Pampas! Now we are plunged into profound darkness and cold, like the Esquimaux of the pole! No, indeed! We have no right to complain, and Nature has done many things in our honour!"

"But," asked Nicholl, "what is the exterior temperature?"

"Precisely that of planetary space," answered Barbicane.

"Then," resumed Michel Ardan, "would not this be an opportunity for making that experiment we could not attempt when we were bathed in the solar rays?"

"Now or never," answered Barbicane, "for we are in the right conditions to verify the temperature of space, and see whether the calculations of Fourier or Pouillet are correct."

"Any way it is cold enough," said Michel. "Look at the interior humidity condensing on the port-lights. If this fall continues the vapour of our respiration will fall around us like snow."

"Let us get a thermometer," said Barbicane.



## ROUND THE MOON

It will be seen that an ordinary thermometer would have given no result under the circumstances in which it was going to be exposed. The mercury would have frozen in its cup, for it does not keep liquid below  $44^{\circ}$  below zero. But Barbicane had provided himself with a spirit thermometer.

Before beginning the experiment this instrument was compared with an ordinary thermometer.

"How shall we manage it?" asked Nicholl.

"Nothing is easier," answered Michel Ardan, who was never at a loss. "Open the port-light rapidly, throw out the instrument; it will follow the projectile; a quarter of an hour after take it in."

"With your hand?" asked Barbicane.

"With my hand," answered Michel.

"Well, then, my friend, do not try it," said Barbicane, "for the hand you draw back will be only a stump, frozen and deformed by the frightful cold."

"Really?"

"You would feel the sensation of a terrible burn, like one made with a red-hot iron, for the same thing happens when heat is brutally taken from our body as when it is exposed to it. Besides, I am not sure that objects thrown out still follow us."

"Why?" said Nicholl.

"Because if we are passing through any atmosphere, however slightly dense, these objects will be delayed. Now the darkness prevents us verifying whether they still float around us. Therefore, in order not to risk our thermometer, we will tie something to it, and so easily pull it back into the interior."

Barbicane's advice was followed. Nicholl threw the instrument out of the rapidly-opened port-light, holding it by a very short cord, so that it could be rapidly drawn in. The window was only open one second, and yet that one second was enough to allow the interior of the projectile to become frightfully cold.

*"Mille diables!"* cried Michel Ardan, "it is cold enough here to freeze white bears!"

Barbicané let half an hour go by, more than sufficient time to allow the instrument to descend to the level of the temperature of space. The thermometer was then rapidly drawn in.

"One hundred and forty degrees Centigrade below zero!" exclaimed Barbicané.

M. Pouillet was right, not Fourier. Such was the frightful temperature of outer space! Such perhaps that of the lunar continents when the orb of night loses by radiation all the heat which she absorbs during the fifteen days of sunshine.

## CHAPTER XV

### HYPERBOLA OR PARABOLA

OUR readers will probably be astonished that Barbicane and his companions were so little occupied with the future in store for them in their metal prison, carried along in the infinitude of ether. Instead of asking themselves where they were going, they lost their time in making experiments, just as if they had been comfortably installed in their own laboratories.

It might be answered that men so strong-minded were above such considerations, that such little things did not make them uneasy, and that they had something else to do than to think about their future.

The truth is that they were not masters of their projectile—that they could neither stop it nor alter its direction. A seaman can direct the head of his ship as he pleases. They, on the contrary, had no control over their vehicle. No manœuvre was possible to them. Hence their not troubling themselves, or “let things go” state of mind.

Where were they at that moment, 8 a.m. during that day, called upon earth the sixth of December? Certainly in the neighbourhood of the moon, and even near enough for her to appear like a vast black screen upon the firmament. As to the distance which separated them, it was impossible to estimate it. The projectile, kept up by inexplicable forces, had grazed the north pole of the satellite at less than twenty-five miles’ distance. But had that distance increased or diminished since they had been in the cone of shadow? There was no landmark by which to estimate either the direction or the velocity of the projectile. Perhaps it was going rapidly away from the disc and would soon leave the pure shadow. Perhaps, on the contrary, it was approaching

it, and would before long strike against some elevated peak in the invisible atmosphere, which would have perhaps ended the brave adventure.

A discussion began upon this subject, and Michel Ardan, always rich in explanations, gave out the opinion that the projectile, restrained by lunar attraction, would end by falling on the moon like an aerolite on to the surface of the terrestrial globe.

"In the first place," answered Barbicane, "all aerolites do not fall upon the surface of the earth; only a small proportion do so. Therefore if we are aerolites it does not necessarily follow that we shall fall upon the moon."

"Still," answered Michel, "if we get near enough——"

"Error," replied Barbicane. "Have you not seen shooting stars by thousands in the sky at certain times of the year?"

"Yes."

"Well, those stars, or rather corpuscles, only shine because of friction with the earth's atmosphere. Now, if they pass through the atmosphere, they pass at less than 16 miles from our globe, and yet they rarely fall. It is the same with our projectile. It may approach very near the moon, and yet not fall upon it."

"But then," asked Michel, "I am curious to know how our vehicle would behave in space."

"I only see two alternatives," answered Barbicane, after some minutes' reflection.

"What are they?"

"The projectile has the choice between two mathematical curves, and it will follow one or the other according to its velocity, but which I cannot now estimate."

"Yes, it will either describe a parabola or an hyperbola."

"Yes," answered Barbicane, "with a certain speed it will describe a parabola, and with greater speed an hyperbola."

"I like those grand words!" exclaimed Michel Ardan. "I know at once what you mean. And what is your parabola, if you please?"

"My friend," answered the captain, "a parabola is the



curve produced when a cone is cut through vertically to its base."

"Oh!" said Michel in a satisfied tone.

"It is about the same path as a shell from a gun describes."

"Just so. And an hyperbola?" asked Michel.

"It is a curve formed by a section of a cone when the cutting plane makes a greater angle with the base than the side of the cone makes."

"Is it possible?" exclaimed Michel Ardan in the most serious tone, as if he had been informed of a grave event.

"Then remember this, Captain Nicholl, what I like in your definition of the hyperbola—I was going to say of the hyperhumbug—is that it is still less easy to understand than the word you pretend to define."

Nicholl and Barbicane paid no attention to Michel Ardan's jokes. They had launched into a scientific discussion. They were eager about what curve the projectile would take. One was for the hyperbola, the other for the parabola. They gave each other reasons bristling with  $x$ 's. Their arguments were presented in a language which made Michel Ardan jump. The discussion was lively, and neither of the adversaries would sacrifice his curve.

This scientific dispute was prolonged until Michel Ardan became impatient and said—

"I say, Messrs. Cosine, do leave off throwing your hyperbolas and parabolas at one's head. I want to know the only interesting thing about the business. We shall follow one or other of your curves. Very well. But where will they take us to?"

"Nowhere," answered Nicholl.

"How nowhere?"

"Evidently they are unfinished curves, prolonged indefinitely!"

"Ah, experts! What does it matter about hyperbola or parabola if they both carry us indefinitely into space?"

Barbicane and Nicholl could not help laughing. They cared for science for its own sake. Never had a more useless

question been discussed at a more inopportune moment. The fatal truth was that the projectile, whether hyperbolically or parabolically carried along, would never strike against either the earth or the moon.

What would become of these bold travellers in the most immediate future? If they did not die of hunger or thirst, they would in a few days, when gas failed them, die for want of air, if the cold had not killed them first!

Still, although it was so important to economize gas, the excessive lowness of the surrounding temperature forced them to consume a certain quantity. They could not do without either its light or heat. Happily the heat developed by the Reiset and Regnault apparatus slightly lifted the temperature of the projectile, and without spending much they could raise it to a bearable degree.

In the meantime observation through the port-lights had become very difficult. The steam inside the projectile condensed upon the panes and froze immediately. However, they could record several phenomena of the highest interest.

In fact, if the invisible disc had any atmosphere, the shooting stars would be seen passing through it. If the projectile itself passed through it, might they not hear some noise echoed—a storm, for instance, an avalanche, or a volcano in activity? Barbicane and Nicholl, standing like astronomers at their port-lights, watched with scrupulous patience.

But the disc remained mute and dark. It did not answer the many questions chasing through their minds.

This provoked from Michel a reflection that seemed correct enough.

“If ever we recommence our journey, we shall do well to choose the time when the moon is new.”

“True,” answered Nicholl, “that circumstance would have been more favourable. I agree that the moon, bathed in sunlight, would not be visible during the passage, but on the other hand the earth would be full. And if we are dragged round the moon like we are now, we should at

least have the advantage of seeing the disc magnificently lighted up."

"Well said, Nicholl," replied Michel Ardan. "What do you think about it, Barbicane?"

"I think this," answered the grave president: "if ever we recommence this journey, we shall start at the same time, and under the same circumstances. Suppose we had reached our goal, would it not have been better to find the continents in full daylight instead of dark night? Would not our first installation have been made under better circumstances? Yes, evidently. As to the invisible side, we could have visited that in our exploring expeditions on the lunar globe. So, therefore, the time of the full moon was well chosen. But we ought to have reached our goal, and in order to have reached it we ought not to have deviated from our path."

"There is no answer to make to that," said Michel Ardan. "Yet we have missed a fine opportunity for seeing the moon! Who knows whether the inhabitants of the other planets are not more advanced than the scientists of the earth on the subject of their satellites?"

The following answer might easily have been given to Michel Ardan's remark: Yes, other satellites, on account of their greater nearness, have made the study of them easier. The inhabitants of Saturn, Jupiter, and Uranus, if they exist, have been able to establish communication with their moons much more easily. The four satellites of Jupiter gravitate at a distance of 108,260 leagues, 172,200 leagues, 274,700 leagues, and 480,130 leagues. But these distances are reckoned from the centre of the planet, and by taking away the radius, which is 17,000 to 18,000 leagues, it will be seen that the first satellite is at a much less distance from the surface of Jupiter than the moon is from the centre of the earth. Of the eight moons of Saturn, four are near. Diana is 84,600 leagues off; Thetys, 62,966 leagues; Enceladus, 48,191 leagues; and lastly, Mimas is at an average distance of 34,500 leagues only. Of the eighteen satellites of



Uranus, the first, Ariel, is only 51,520 leagues from the planet.

Therefore, upon the surface of those three stars, an experiment similar to that of President Barbicane would have presented less difficulties. If, therefore, their inhabitants have attempted the enterprise, they have, perhaps, acquainted themselves with the constitution of that half of the disc which their satellite hides eternally from their eyes. But if they have never left their planet, they do not know more about them than the astronomers of the earth.

In the meantime the projectile was describing in the darkness that incalculable path which no landmark allowed them to find out. Was its direction altered either under the influence of lunar attraction or under the action of some unknown body? Barbicane could not tell. But a change had taken place in the relative position of the vehicle, and Barbicane became aware of it about 4 a.m.

The change consisted in this, that the bottom of the projectile was turned towards the surface of the moon and kept itself perpendicular with its axis. The attraction or gravitation had caused this modification. The heaviest part of the craft inclined towards the invisible disc exactly as if it had fallen towards it.

Was it falling then? Were the travellers at last about to reach their desired goal? No. And the observation of one landmark, inexplicable in itself, demonstrated to Barbicane that his projectile was not nearing the moon.

There was a flash of light on the horizon formed by the black disc. This point could not be mistaken for a star. It was a reddish flame, which grew gradually larger—an uncontested proof that the projectile was getting nearer it, and not falling normally upon the surface of the satellite.

“A volcano! It is a volcano in activity!” exclaimed Nicholl—“an eruption of the interior fires of the moon. That world, then, is not quite extinguished.”

“Yes, an eruption!” answered Barbicane, who studied the



phenomenon carefully through his night-glass. "What should it be if not a volcano?"

"But then," said Michel Ardan, "air is necessary to feed that combustion, therefore, there is some atmosphere on that part of the moon."

"Perhaps so," answered Barbicane, "but not necessarily. A volcano, by the decomposition of certain substances, can furnish itself with oxygen, and so throw up flames into the void. It seems to me, too, that that eruption has the intensity and brilliancy of objects the combustion of which is produced in pure oxygen. We must not be in a hurry to affirm the existence of a lunar atmosphere."

The burning mountain was situated at the 45th degree of south latitude on the invisible part of the disc. But to the great disappointment of Barbicane the projectile swerved away from the eruption, therefore he could not exactly determine its nature. Half an hour after it had first been seen this luminous point disappeared over the horizon. Still having observed of this phenomenon was a considerable fact in lunar studies. It proved that all heat had not yet disappeared from the interior of this globe, and where heat exists, who may affirm that the vegetable kingdom or even the animal kingdom itself, has not until now resisted the destructive influences? The existence of this volcano in eruption, indisputably established by earthly astronomers, was favourable to the theory of the habitability of the moon.

Barbicane became absorbed in reflection. He forgot himself in a mute reverie, filled with the mysterious destinies of the lunar world. He was trying to connect the facts observed up till then, when a fresh incident recalled him suddenly to reality.

This incident was more than a cosmic phenomenon; it was a threatening danger, the consequences of which might be disastrous.

Suddenly in the midst of the ether, in the profound darkness, an enormous mass had appeared. It was like a moon, but a burning moon of almost unbearable brilliancy,



An eruption of the interior fires of the moon

outlined as it was on the total obscurity of space. This mass, of a circular form, threw such light that it filled the projectile. The faces of Barbicane, Nicholl, and Michel Ardan, bathed in its white waves, looked spectral, livid.

"The devil!" cried Michel Ardan. "How hideous we are! Whatever is that wretched moon?"

"It is a bolis," answered Barbicane.

"A bolis, on fire, in the void?"

"Yes."

This globe of fire was indeed a bolis. Barbicane was not mistaken. But if these cosmic meteors, seen from the earth, present an inferior light to that of the moon, here, in the dark ether, they shone magnificently. These wandering bodies carry in themselves the principle of their own incandescence; the surrounding air is not necessary. And, indeed, if certain of these bodies pass through our atmosphere at two or three leagues from the earth, others describe their trajectory at a distance the atmosphere cannot reach. Some of these meteors are from one to two miles wide, and move at a speed of forty miles a second, following an opposite direction from the movement of the earth.

This shooting star suddenly appeared in the darkness at a distance of at least 100 leagues, and measured, according to Barbicane's estimate, a diameter of 2,000 metres. It moved with the speed of about thirty leagues a minute. It cut across the route of the projectile, and would reach it in a few minutes. As it approached it grew to an enormous proportion.

If possible, let the situation of the travellers be imagined! It is impossible to describe it. In spite of their courage, their *sang-froid*, their carelessness of danger, they were mute, motionless, with stiffened limbs, a prey to fearful terror. Their projectile, the course of which they could not alter, was running straight on to this burning mass, more intense than the open mouth of a furnace. They seemed to be rushing towards an abyss of fire.

Barbicane seized the hands of his two companions, and



all three looked through their half-closed eyelids at the red-hot asteroid. If they still thought at all, they must have given themselves up as lost!

Two minutes after the sudden appearance of the bolis, two centuries of agony, the projectile seemed about to strike against it, when the ball of fire burst like a bomb, but without making any noise in the void.

Nicholl uttered a cry. His companions and he rushed to the port-lights.

What a spectacle! What pen could describe it, what palette would be rich enough in colours to reproduce its magnificence?

It was like the opening of a crater, or the spreading of an immense fire. Thousands of luminous fragments lit up space with their fires. Every size, colour, and shade were there. There were yellow, red, green, grey, a crown of multi-coloured fireworks. There only remained of the enormous and terrible globe pieces carried in all directions, each an asteroid in its turn, some shining like swords, some surrounded by white vapour, others leaving behind them a trail of cosmic dust.

These incandescent blocks crossed each other, knocked against each other, and were scattered into smaller fragments, of which some struck the projectile. Its left window was even cracked by the violent shock. It seemed to be floating in a shower of bullets, of which the least could annihilate it in an instant.

The light which saturated the ether was of incomparable intensity, for these asteroids dispersed it in every direction. At a certain moment it was so bright that Michel dragged Barbicane and Nicholl to the window, exclaiming—

“The invisible moon is at last visible!”

And all three, across the illumination, saw for a few seconds that mysterious disc which the eye of man perceived for the first time.

What did they distinguish across that distance which they could not estimate? Long bands across the disc, veritable



clouds formed in a very restricted atmospheric medium, from which emerged not only all the mountains, but every minute detail, amphitheatres, yawning craters, such as exist on the visible face. Then immense tracts, no longer arid plains, but veritable seas, oceans which reflected in their liquid mirror all the dazzling magic of the fires of space. Lastly, on the surface of the continents, vast dark masses, such as immense forests would look like under the rapid illumination of a flash of lightning.

Was it an illusion, an error of the eyes, an optical deception? Dared they pronounce upon the question of its habitability after so slight a glimpse of the invisible disc?

By degrees the illumination of space gradually died out, its accidental brilliancy lessened, the asteroids fled away, and went out in the distance. The ether resumed its habitual darkness; the stars, for one moment eclipsed, shone in the firmament, and the disc of which scarcely a glimpse had been caught, was lost in its impenetrable night.

## CHAPTER XVI

### THE SOUTHERN HEMISPHERE

THE projectile had just escaped a terrible danger, a danger quite unforeseen. Who would have imagined such a meeting of asteroids? These wandering bodies might prove serious perils to the travellers. They were to them like so many rocks in the sea of ether, which they could do nothing to avoid. But did these adventurers of space complain? No, as Nature had given them the splendid spectacle of a cosmic meteor shining by formidable expansion, as this incomparable display of fireworks had lighted for a few seconds the invisible surface of the moon. During that rapid peep, continents, seas, and forests had appeared to them. Then the atmosphere did give its life-giving particles? Questions still not solved, eternally asked by American curiosity.

It was then 3.30 p.m. The projectile was still describing its curve round the moon. Had its route again been modified by the meteor? The projectile ought, however, to describe a curve determined by the laws of mechanics. Barbicane inclined to the opinion that this curve would be a parabola and not an hyperbola. However, if the parabola was admitted, the craft ought soon to come out of the cone of shadow thrown into the space on the opposite side to the sun. This cone, in fact, is very narrow, the angular diameter of the moon is so small compared to the diameter of the orb of day. Until now the projectile had moved in profound darkness. Whatever its speed had been—and it could not have been slight—it still continued in its diverted path. That fact was evident, but perhaps that would not have been the case in a rigidly parabolical course. This was a fresh problem which tormented Barbicane's brain.

Neither of the travellers thought of taking a minute's

rest. Each watched for some unexpected incident which should throw a new light on their studies. About five o'clock Michel distributed to them, by way of dinner, some morsels of bread and cold meat, which were rapidly eaten, whilst no one thought of leaving the port-light, the panes of which were becoming encrusted under the condensation of vapour.

About 5.45 p.m. Nicholl, armed with his telescope, noted upon the southern border of the moon, and in the direction followed by the projectile, a few brilliant points outlined against the dark screen of the sky. They looked like a succession of sharp peaks with profiles in a tremulous line. They were rather brilliant and could not be mistaken. There was no longer any question of a simple meteor, of which that luminous line had neither the colour nor the mobility, nor of a volcano in eruption. Barbicane did not hesitate to declare what it was.

"The sun!" he exclaimed.

"What! the sun!" answered Nicholl and Michel Ardan.

"Yes, my friends, it is the radiant orb itself, lighting up the summit of the mountains situated on the southern border of the moon. We are evidently approaching the South Pole!"

"After having passed the North Pole," answered Michel. "Then we have been all round our satellite."

"Yes, friend Michel."

"Then we have no more hyperbolas, no more parabolas, no more open curves to fear!"

"No, but a closed curve."

"Which is called——"

"An ellipsis. Instead of being lost in the interplanetary spaces it is possible that the projectile will describe an elliptical orbit round the moon."

"Really!"

"And that it will become its satellite."

"Moon of the moon," exclaimed Michel Ardan.

"Only I must tell you, my worthy friend, that we are none the less lost men on that account!"

"No, but in another and much pleasanter way!" answered the careless Frenchman, with his most amiable smile.

President Barbicane was right. By describing this elliptical orbit the projectile was going to gravitate eternally round the moon—a moon round the moon. It was a new star added to the solar world, a microcosm peopled by three inhabitants, whom want of air would kill before long. Barbicane, therefore, could not rejoice at the position imposed on the projectile by the double influence of the centripetal and centrifugal forces. His companions and he were again going to see the visible face of the disc. Perhaps their existence would last long enough for them to perceive for the last time the full earth superbly lighted by the rays of the sun! Perhaps they might throw a last adieu to the globe they were never to see again! Then their projectile would be nothing but an extinct mass, dead like those inert asteroids which circulate in the ether. A single consolation remained to them: it was that of seeing the darkness and returning to light, it was that of again entering the zones bathed by solar radiation!

In the meantime the mountains recognized by Barbicane stood out more and more from the dark mass. They were Mounts Dœrfel and Leibnitz, which stand on the southern circumpolar region of the moon.

All the mountains of the visible hemisphere have been measured with perfect exactitude. This perfection will, no doubt, seem astonishing. The altitude of the lunar mountains may be no less exactly determined than that of the mountains of the earth.

The method generally employed is that of measuring the shadow thrown by the mountains, whilst taking into account the altitude of the sun at the moment of observation. This method also allows the calculating of the depth of craters and cavities on the moon. Galileo used it, and since Messrs. Bœer and Moedler have employed it with the greatest success.



Galileo, after recognizing the existence of the lunar mountains, was the first to employ the method of calculating their heights by the shadows they throw. He attributed to them, as it has already been shown, an average of 9,000 yards. Hevelius singularly reduced these figures, which Riccioli, on the contrary, doubled. All these measures were exaggerated. Herschel, with his more perfect instruments, approached nearer the truth. But it must be finally sought in the accounts of modern observers.

Messrs. Bœer and Moedler, the most perfect students of the moon in the whole world, have measured 1,095 lunar mountains. It results from their calculations that 6 of these mountains rise above 5,800 metres, and 22 above 4,800. The highest summit of the moon measures 7,603 metres; it is, therefore, less than those of the earth, of which some are 1,000 yards higher. But one remark must be made. If the respective volumes of the two orbs are compared the lunar mountains are relatively higher than the terrestrial. The lunar ones form  $\frac{1}{70}$  of the diameter of the moon, and the terrestrial only form  $\frac{1}{140}$  of the diameter of the earth. For a terrestrial mountain to attain the relative proportions of a lunar mountain, its perpendicular height ought to be  $6\frac{1}{2}$  leagues. Now the highest is not four miles.

Thus, then, to proceed by comparison, the chain of the Himalayas counts three peaks higher than the lunar ones, Mount Everest, Kunchinjuga and Dwalagiri. Mounts Dœrfel and Leibnitz, on the moon, are as high as Jewahir in the same chain.

Such are the points of comparison that allow the appreciation of the altitude of lunar mountains. Now the path followed by the projectile dragged it precisely towards that mountainous region of the southern hemisphere where rise the finest mountains on the moon.

## CHAPTER XVII

### TYCHO

At 6 p.m. the projectile passed the South Pole at less than thirty miles, a distance equal to that already reached at the North Pole.

At that moment the travellers re-entered the beneficent sunshine. They saw once more the stars moving slowly from east to west, and saluted it with a triple hurrah. With its light came also its heat, which soon pierced the middle walls. The windows resumed their accustomed transparency. Their "layer of ice" melted as if by enchantment. The gas was immediately extinguished by way of economy.

"Ah!" said Nicholl, "sunshine is good! How impatiently after their long nights the Selenites must await the reappearance of the orb of day!"

"Yes," answered Michel Ardan, "imbibing, as it were, the brilliant ether, light and heat, all life is in them."

At that moment the bottom of the projectile moved slightly from the lunar surface in order to describe a rather long elliptical orbit. From that point, if the earth had been full, Barbicane and his friends could have seen it again. But, drowned in the sun's radiation, it remained absolutely invisible. Another spectacle attracted their eyes, presented by the southern region of the moon, brought by the telescopes to within half a mile. They left the port-lights no more, and noted all the details of the strange continent.

Mounts Dœrfel and Leibnitz formed two separate groups stretching nearly to the South Pole; the former group extends from the Pole to the 84th parallel on the eastern part of the orb; the second, starting from the eastern border, stretches from the 65th degree of latitude to the Pole.

On their capriciously-formed ridge appeared dazzling sheets of light.

"It is snow," cried Barbicane.

"Snow?" echoed Nicholl.

"Yes, Nicholl, snow, the surface of which is deeply frozen. Look how it reflects the luminous rays. Cooled lava would not give so intense a reflection. Therefore there is water and air upon the moon, as little as you like, but the fact can no longer be contested."

No, it could not be, and if ever Barbicane saw the earth again his notes would testify to this fact, important in lunar observations.

These Mounts Dœrfel and Leibnitz arose in the midst of plains of moderate extent, bounded by an indefinite succession of amphitheatres and circular ramparts. These two chains are the only ones which are met with in the region of amphitheatres. Relatively they are not very broken, and only throw out here and there some sharp peaks, the highest of which measures 7,603 metres.

The projectile hung high above all this, and their relief disappeared in the intense brilliancy of the disc.

Then reappeared to the travellers that original view of the lunar landscapes, raw in tone, without gradation of colours, only white and black, for diffused light was wanting. Still the sight of this desolate world was very curious on account of its very strangeness. They were moving above this chaotic region as if carried along by the breath of a tempest, seeing the summits fly under their feet, looking down the cavities, climbing the ramparts, sounding the mysterious holes. But there was no trace of vegetation, no appearance of cities, nothing but stratifications, lava streams, polished like immense mirrors, which reflect the solar rays with unbearable brilliancy. There was no appearance of a living world, everything of a dead one, where the avalanches rolling from the summit of the mountains rushed noiselessly. They had plenty of movement, but noise was still absent.

Barbicane established the fact, by observation, that the



reliefs on the borders of the disc, although they had been acted upon by different forces to those of the central region, presented a uniform conformation.

Michel Ardan, however, thought he recognised a heap of ruins, to which he drew Barbicane's attention. It was situated in about the 80th parallel and  $30^{\circ}$  longitude. This heap of stones, pretty regularly made, was in the shape of a vast fortress, overlooking one of those long furrows which served as river-beds in ante-historical times. Not far off rose to a height of 5,646 metres the circular mountain called Short, equal to the Asiatic Caucasus. Michel Ardan, with his habitual ardour, maintained "the evidences" of his fortress. Below he perceived the dismantled ramparts of a town; here the arch of a portico, still intact; there two or three columns lying on their side; farther on a succession of archpieces, which must have supported an aqueduct; in another part the sunken pillars of a gigantic bridge run into the thickest part of the furrow. He distinguished all that, but with so much imagination in his eyes, through a telescope so fanciful, that his observation cannot be relied upon. And yet who would affirm, who would dare to say, that the amiable fellow has not really seen what his two companions would not see?

The moments were too precious to be sacrificed to an idle discussion. The Selenite city, whether real or pretended, had disappeared in the distance. The projectile began to get further away from the lunar disc, and the details of the ground began to be lost in a confused jumble. The reliefs, amphitheatres, craters, and plains alone remained, and still showed their boundary-lines distinctly.

At that moment there stretched to the left one of the finest amphitheatres in lunar orography. It was Newton, which Barbicane easily recognized.

Newton is situated in exactly  $77^{\circ}$  south lat. and  $16^{\circ}$  east long. It forms a circular crater, the ramparts of which, 7,264 metres high, seemed to be inaccessible.

Barbicane made his companions notice that the height



of that mountain above the surrounding plain was far from being equal to the depth of its crater. This enormous hole was beyond all measurement, and made a gloomy abyss, the bottom of which the sun's rays could never reach. There, according to Humboldt, utter darkness reigns, which the light of the sun and the earth could not break. The mythologists would have made it with justice hell's mouth.

"Newton," said Barbicane, "is the most perfect type of circular mountains, of which the earth possesses no specimen. They prove that the formation of the moon by cooling was due to violent causes, for whilst under the influence of interior fire the reliefs were thrown up to considerable heights, the bottom dropped in, and became lower than the lunar level."

"I do not say no," answered Michel Ardan.

A few minutes after having passed Newton the projectile stood directly over the circular mountain of Moret. It also passed rather high above the summits of Blancanus, and about 7.30 p.m. it reached the amphitheatre of Clavius.

This circle, one of the most remarkable on the disc, is situated in south lat.  $58^{\circ}$  and east long.  $15^{\circ}$ . Its height is estimated at 7,091 metres. The travellers at a distance of 200 miles, reduced by two by the telescopes, could admire the arrangement of this vast crater.

"The volcanoes on earth," said Barbicane, "are only mole-hills compared to the volcanoes of the moon. Measuring the ancient craters formed by the first eruptions of Vesuvius and Etna, they are found to be scarcely 6,000 metres wide. In France the circle of the Cantal measures five miles; in Ceylon the circle of the island is forty miles, and is considered the largest on the globe. What are these diameters compared to that of Clavius, which we are over in this moment?"

"What is its width?" asked Nicholl.

"About seventy miles," answered Barbicane. "This amphitheatre is certainly the largest on the moon, but many are fifty miles wide!"

"Ah, my friends," exclaimed Michel Ardan, "can you imagine what this peaceful orb of night was once like? when these craters vomited torrents of lava and stones, with clouds of smoke and sheets of flame? What a prodigious spectacle, and now what a falling off! This moon is now only the meagre case of fireworks, of which the rockets, serpents, suns, and wheels, after going off magnificently, only leave torn pieces of cardboard. Who can tell the cause, reason, or justification of such cataclysms?"

Barbicane did not listen to Michel Ardan. He was contemplating those ramparts of Clavius, formed of wide mountains several leagues thick. At the bottom of its immense cavity lay hundreds of small extinct craters, making the soil like a sieve, and overlooked by a peak more than 15,000 feet high.

The plain around had a desolate aspect. Nothing so arid as these reliefs, nothing so sad as these ruins of mountains, if so they may be called, as those heaps of peaks and mountains encumbering the ground! The satellite seemed to have been blown up in this place.

The projectile still went on, and the chaos was still the same. Circles, craters, and mountains succeeded each other incessantly. No more plains or seas—an interminable Switzerland or Norway. Lastly, in the centre of the creviced region at its culminating point, the most splendid mountain of the lunar disc, the dazzling Tycho, to which posterity still gives the name of the illustrious Danish astronomer.

Whilst observing the full moon in a cloudless sky, there is no one who has not remarked this brilliant point on the southern hemisphere. Michel Ardan, to qualify it, employed all the metaphors his imagination could furnish him with. To him Tycho was an ardent focus of light, a centre of radiation, a crater vomiting flames! It was the axle of a fiery wheel, a sea-star encircling the disc with its silver tentacles, an immense eye darting fire, a nimbus made for Pluto's head! It was a star hurled by the hand of the Creator and fallen upon the lunar surface!

Tycho forms such a luminous concentration that the inhabitants of the earth can see it without a telescope, although they are at a distance of 100,000 leagues. It will, therefore, be readily imagined what its intensity must have been in the eyes of observers placed at fifty leagues only.

Across this pure ether its brilliancy was so unbearable that Barbicane and his friends were obliged to blacken the object-glasses of their telescopes with gas-smoke.

Then, mute, hardly emitting a few admiring interjections, they looked and contemplated. All their sentiments, all their impressions were concentrated in their eyes, as life, under violent emotion, is concentrated in the heart.

Tycho belongs to the system of radiating mountains, like Aristarchus and Copernicus. But it testified the most completely of all to the terrible volcanic action to which the formation of the moon is due.

Tycho is situated in south lat.  $43^{\circ}$  and east long.  $12^{\circ}$ . Its centre is occupied by a crater more than forty miles wide. It affects a slightly elliptical form, and is enclosed by circular ramparts, which on the east and west overlook the exterior plain from a height of 5,000 metres. It is an aggregation of Mont Blancs, placed round a common centre, and crowned with shining rays.

Photography itself could never represent what this incomparable mountain is really like. In fact, it is during the full moon that Tycho is seen in all its splendour.

The distance which separated the travellers from the circular summits of Tycho was not so great that the travellers could not survey its details. Even upon the embankment which formed the ramparts of Tycho, the mountains hanging to the interior and exterior slopes rose in stories like gigantic terraces. They appeared to be higher by 300 or 400 feet on the west than on the east. A town built at the bottom of this circular cavity would have been utterly lost.

Inaccessible and marvellously extended over this ground of picturesque relief! Nature had not left the bottom of

this crater flat and empty. It possessed a special mountain system which made it a world apart. The travellers clearly distinguished the cones, central hills, remarkable movements of the ground, naturally disposed for the reception of masterpieces of Selenite architecture. There was the place for a temple, here for a forum, there the foundations of a palace, there the plateau of a citadel, the whole overlooked by a central mountain 1,500 feet high—a vast circuit which would have held ancient Rome ten times over.

“Ah!” exclaimed Michel Ardan, made enthusiastic by the sight, “what grand towns could be built in this circle of mountains! A tranquil city, a peaceful refuge, away from all human cares! How all misanthropes could live there, all haters of humanity, all those disgusted with social life!”

“All! It would be too small for them!” replied Barbicane simply.



## CHAPTER XVIII

### GRAVE QUESTIONS

IN the meantime the projectile had passed the neighbourhood of Tycho. Barbicane and his two friends then observed, with the most scrupulous attention, those brilliant circles.

What was this radiating aureole? What geological phenomenon had caused those ardent beams? This question justly occupied Barbicane. Under his eyes, in every direction, ran luminous furrows, with raised banks and concave middle, some ten miles, others more than twenty miles wide. These shining trails ran in certain places at least 300 leagues from Tycho, and seemed to cover, especially towards the east, north-east, and north, half the southern hemisphere. One of these furrows stretched as far as the amphitheatre of Neander, situated on the 40th meridian. Another went rounding off through the Sea of Nectar and broke against the chain of the Pyrenees after a run of 400 leagues; others towards the west covered with a luminous network the Sea of Clouds and the Sea of Humours.

What was the origin of these shining rays running equally over plains and reliefs, however high? They all started from a common centre, the crater of Tycho.

Herschel attributed their brilliant aspect to ancient streams of lava congealed by the cold, an opinion which has not been generally accepted. Other astronomers have seen in these inexplicable rays a kind of *moraines*, ranges of erratic blocks thrown out at the epoch of the formation of Tycho.

"And why should it not be so?" Nicholl asked Barbicane, who rejected these different opinions at the same time that he related them.

"Because the regularity of these luminous lines, and the violence necessary to send them to such a distance, are inexplicable."

"*Parbleu!*" replied Michel Ardan. "I can easily explain, to myself, the origin of these rays."

"Indeed," said Barbicane.

"Yes," resumed Michel. "Why should they not be the cracks caused by the shock of a bullet or a stone upon a pane of glass?"

"Good," replied Barbicane, smiling; "and what hand would be powerful enough to hurl the stone that would produce such a shock?"

"A hand is not necessary," answered Michel, who would not give in; "and as to the stone, let us say it is a comet."

"Ah! comets?" exclaimed Barbicane; "those much-abused bodies! My worthy Michel, your explanation is not bad, but your comet is not wanted. The shock might have come from the interior of the planet. A violent contraction of the lunar crust whilst cooling would be enough to make that gigantic crack."

"Contraction let it be—something like a lunar colic," answered Michel Ardan.

"Besides," added Barbicane, "that is also the opinion of an English scientist, Nasmyth, and it seems to me to explain the radiation of these mountains sufficiently."

"That Nasmyth was no fool!" answered Michel.

The travellers, who could never weary of such a spectacle, long admired the splendours of Tycho. Their projectile, bathed in radiation of both the sun and moon, must have appeared like a globe of fire. They had, therefore, suddenly passed from considerable cold to intense heat. Nature was thus preparing them to become Selenites.

To become Selenites! That idea again brought up the question of the habitability of the moon. After what they had seen, could the travellers solve it? Could they conclude for or against? Michel Ardan asked his two friends to give their opinion, and asked them outright if they thought

that humanity and animality were represented in the lunar world.

"I think we cannot answer," said Barbicane, "but in my opinion the question ought not to be stated in that form. I ask to be allowed to state it differently."

"State it as you like," answered Michel.

"This is it," resumed Barbicane. "The problem is double, and requires a double solution. Is the moon habitable? Has it been inhabited?"

"Right," said Nicholl. "Let us first see if the moon is habitable."

"To tell the truth, I know nothing about it," replied Michel.

"And I answer in the negative," said Barbicane. "In her actual state, with her certainly very slight atmosphere, her seas mostly dried up, her insufficient water, her restricted vegetation, her abrupt alternations of heat and cold, her nights and days 354½ hours long, the moon does not appear habitable to me, nor propitious to the development of the animal kingdom, nor sufficient for the needs of existence such as we understand it."

"Agreed," answered Nicholl; "but is not the moon habitable for beings differently organized to us?"

"That question is more difficult to answer," replied Barbicane. "I will try to do it, however, but I ask Nicholl if movement seems to him the necessary result of existence, under no matter what organization?"

"Without the slightest doubt," answered Nicholl.

"Well, then, my worthy companion, my answer will be that we have seen the lunar continent at a distance of 500 yards, and that nothing appeared to be moving on the surface of the moon. The presence of no matter what form of humanity would be betrayed by appropriations, different constructions, or even ruins. What did we see? Everywhere the geological work of Nature, never the work of man. If, therefore, representatives of the animal kingdom exist upon the moon, they have taken refuge in those bottomless



cavities which the eye cannot reach. And I cannot admit that either, for they would have left traces of their passage upon the plains which the atmosphere, however slight, covers. Now these traces are nowhere visible. Therefore the only theory that remains is one of living beings without movement or life."

"You might just as well say living creatures who are not alive."

"Precisely," answered Barbicane, "which for us has no meaning."

"Now may we formulate our opinion?" said Michel.

"Yes," answered Nicholl.

"Very well," resumed Michel Ardan; "the Scientific Commission, meeting in the projectile of the Gun Club, after having supported its arguments upon fresh facts lately observed, decides unanimously upon the question of the habitability of the moon—'No, the moon is not inhabited.'"

This decision was taken down by Barbicane in his notebook, where he had already written a report of the sitting of December 6th.

"Now," said Nicholl, "let us attack the second question, depending on the first. I therefore ask the honourable Commission if the moon is not habitable, has it been inhabited?"

"Answer, Citizen Barbicane," said Michel Ardan.

"My friends," answered Barbicane, "I did not undertake this journey to form an opinion upon the ancient habitability of our satellite. I may add that my personal observations only confirm me in this opinion. I believe, I even affirm, that the moon has been inhabited by a human race organized like ours, that it has produced animals anatomically formed like terrestrial animals; but I add that these races, human or animal, have had their day, and are for ever extinct."

"Then," asked Michel, "the moon is an older world than the earth?"

"No," answered Barbicane with conviction, "but a world that has grown old more quickly, whose formation



and decay have been more rapid. Relatively the organizing forces of matter have been much more violent in the interior of the moon than in the interior of the earth. The actual state of this disc, broken up, tormented, and swollen, proves this abundantly. In their origin the moon and the earth were only gases. These gases became liquids under different influences, and the solid mass was formed afterwards. But it is certain that our globe was gas or liquid still when the moon, already solidified by cooling, became habitable."

"I believe that," said Nicholl.

"Then," resumed Barbicane, "it was surrounded by atmosphere. The water held in by the gassy element could not evaporate. Under the influence of air, water, light and heat, solar and central, vegetation took possession of these continents prepared for its reception, and certainly life manifested itself about that epoch, for Nature does not spend itself stupidly, and a world so marvellously habitable must have been inhabited."

"Still," answered Nicholl, "many things must have prevented the expansion of the vegetable and animal kingdoms. The days and nights 354½ hours long, for example."

"At the terrestrial poles," said Michel, "they last six months."

"That is not a valuable argument, as the poles are not inhabited."

"In the actual state of the moon," resumed Barbicane, "the long nights and days create differences of temperature which the human body cannot stand, but it was not so in its earlier history. The atmosphere enveloped the disc with a fluid matter. Vapour deposited itself in the form of clouds. This natural screen tempered the power of the solar rays, and retained the nocturnal radiation. Both light and heat could diffuse themselves in the air. Hence there was equilibrium between the influences which no longer exists now that the atmosphere has almost entirely disappeared. Besides, I shall astonish you——"

"Astonish us?" said Michel Ardan.

"But I believe that at the time when the moon was inhabited the nights and days did not last  $354\frac{1}{2}$  hours!"

"Why so!" asked Nicholl quickly.

"Because it is very probable that then the moon's movement of rotation on her axis was not equal to her movement of revolution, an equality which puts every point of the lunar disc under the action of the solar rays for fifteen days."

"Agreed," answered Nicholl; "but why should these movements not have been equal, since they are so actually?"

"Because that equality has only been determined by terrestrial attraction. Now, how do we know that this attraction was powerful enough to influence the movements of the moon at the time the earth was still fluid?"

"True," replied Nicholl; "and who can say that the moon has always been the earth's satellite?"

"And who can say," exclaimed Michel Ardan, "that the moon did not exist before the earth?"

"Those," said he, "are speculations too high, problems really insoluble. Suffice it to say that even under difficult conditions life was possible."

"Then," asked Michel Ardan, "humanity has quite disappeared from the moon?"

"Yes," answered Barbicane, "after having, doubtless, existed for thousands of centuries. Then gradually the atmosphere becoming rarefied, the disc will again be uninhabitable like the terrestrial globe will one day become by cooling."

"By cooling?"

"Certainly," answered Barbicane. "As the interior fires became extinguished the lunar disc became cool. By degrees the consequences of this phenomenon came about—the disappearance of animal life and the disappearance of vegetation. Soon the atmosphere became rarefied, and was probably drawn away by terrestrial attraction; the breathable air disappeared, and so did water by evaporation. At that time the moon became uninhabitable, and was no longer inhabited. It was a dead world like it is to-day."

## ROUND THE MOON

"And you say that the like fate is reserved for the earth?"

"Very probably."

"But when?"

"When the cooling of its crust will have made it uninhabitable."

"Has the time it will take our unfortunate globe to die been calculated?"

"Certainly."

"And you know the answer?"

"Perfectly."

"Then tell us, sulky expert—you make me boil with impatience."

"Well, my worthy Michel," answered Barbicane tranquilly, "it is well known what decrease of temperature the earth suffers in the lapse of a century. Now, according to certain calculations, that average temperature will be brought down to zero after a period of 400,000 years!"

"Four hundred thousand years!" exclaimed Michel. "Ah! I breathe again! I was really frightened. I imagined from listening to you that we had only fifty thousand years to live!"

Barbicane and Nicholl could not help laughing at their companion's uneasiness. Then Nicholl, who wanted to have done with it, reminded them of the second question to be settled.

"Has the moon been inhabited?" he asked.

The answer was unanimously in the affirmative.

During this discussion, fruitful in somewhat hazardous theories, although it resumed the general ideas of science on the subject, the projectile had run rapidly towards the lunar equator, at the same time that it went farther away from the lunar disc. It had passed the circle of Willem, and the 40th parallel, at a distance of 400 miles. Then leaving Pitatus to the right, on the 30th degree, it went along the south of the Sea of Clouds, of which it had already approached the north. Different amphitheatres appeared confusedly under the white light of the full moon—Bouillaud, Purback, almost

square with a central crater, then Arzachel, whose interior mountain shone with indefinable brilliancy.

At last, as the projectile went farther and farther away, the details faded from the travellers' eyes, the mountains were confounded in the distance, and all that remained of the marvellous, fantastical, and wonderful satellite of the earth was the imperishable remembrance.



*I have read up to this page.  
I could not read further.  
The end of the world.*

## CHAPTER XIX

### A STRUGGLE WITH THE IMPOSSIBLE

FOR some time Barbicane and his companions, mute and pensive, looked at this world, which they had only seen from a distance, like Moses saw Canaan, and from which they were going away for ever. The position of the projectile relatively to the moon was modified, and now its lower end was turned towards the earth.

This change, verified by Barbicane, surprised him greatly. If the projectile were going to gravitate round the satellite in an elliptical orbit, why was not its heaviest part turned towards it like the moon to the earth? There, again, was an obscure point.

By watching the progress of the projectile they could see that it was following a curve away from the moon similar to that by which it approached her. It was, therefore, describing a very long ellipsis which would probably extend to the point of equal attraction, where the influences of the earth and her satellite are neutralized.

Such was the conclusion which Barbicane correctly drew from the facts observed, a conviction which his two friends shared with him.

Questions immediately began to shower upon him.

"What will become of us after we have reached the neutral point?" asked Michel Ardan.

"That is unknown," answered Barbicane.

"But we can make suppositions, I suppose?"

"We can make two," answered Barbicane. "Either the velocity of the projectile will then be insufficient, and it will remain entirely motionless on that line of double attraction——"

"I would rather have the other supposition, whatever it is," replied Michel.

"Or the velocity will be sufficient," resumed Barbicane, "and it will continue its elliptical orbit, and gravitate eternally round the moon."

"Not very consoling that revolution," said Michel, "to become the humble servants of a moon whom we are in the habit of considering our servant. And is that the future that awaits us?"

Neither Barbicane nor Nicholl answered.

"Why do you not answer?" asked the impatient Michel.

"There is nothing to answer," said Nicholl.

"Can nothing be done?"

"No," answered Barbicane. "Do you pretend to struggle with the impossible?"

"Why not? Ought a Frenchman and two Americans to recoil at such a word?"

"But what do you want to do?"

"Command the motion that is carrying us along!"

"Command it?"

"Yes," resumed Michel, getting animated, "stop it or modify it; use it for the accomplishment of our plans."

"And how, pray?"

"That is your business! If artillerymen are not masters of their bullets they are no longer artillerymen. If the projectile commands the gunner, the gunner ought to be rammed instead into the cannon! Fine experts, truly! who don't know now what to do after having induced me——"

"Induced!" cried Barbicane and Nicholl. "Induced! What do you mean by that?"

"No recriminations!" said Michel. "I do not complain. The journey pleases me. But let us do all that is humanly possible to fall somewhere, if only upon the moon."

"We should only be too glad, my worthy Michel," answered Barbicane, "but we have no means of doing it."

"Can we not modify the motion of the projectile?"

"No."

## ROUND THE MOON

"Nor diminish its speed?"

"No."

"Not even by lightening it like they lighten an overloaded ship?"

"What can we throw out?" answered Nicholl. "We have no ballast on board. And besides, it seems to me that a lightened projectile would go on more quickly."

"Less quickly," said Michel.

"More quickly," replied Nicholl.

"Neither more nor less quickly," answered Barbicane, wishing to make his two friends agree, "for we are moving in the void where we cannot take specific weight into account."

"Very well," exclaimed Michel Ardan in a determined tone; "there is only one thing to do."

"What is that?" asked Nicholl.

"Have breakfast," imperturbably answered the audacious Frenchman, who always brought that solution to the greatest difficulties.

In fact, though that operation would have no influence on the direction of the projectile, it might be attempted without risk, and even successfully from the point of view of the stomach. Decidedly the amiable Michel had only good ideas.

They breakfasted, therefore, at 2 a.m., but the hour was not of much consequence. Michel served up his habitual *menu*, crowned by an amiable bottle out of his secret cellar.

The meal over, observations began again.

The objects they had thrown out of the projectile still followed it at the same invariable distance. It was evident that the craft in its movement round the moon had not passed through any atmosphere, for the specific weight of these objects would have modified their respective distances.

There was nothing to see on the side of the terrestrial globe. The earth was only a day old, having been new at midnight the day before, and two days having to go by before her crescent, disengaged from the solar rays, could



serve as a clock to the Selenites, as in her movement of rotation each of her points always passes the same meridian of the moon every twenty-four hours.

The spectacle was a different one on the side of the moon; the orb was shining in all its splendour amidst innumerable constellations, the rays of which could not trouble its purity. Upon the disc the plains again wore the sombre tint which is seen from the earth. The rest of the nimbus was shining, and amidst the general blaze Tycho stood out like a sun.

Barbicané could not manage any way to appreciate the velocity of the projectile, but reasoning demonstrated that this speed must be uniformly diminishing in conformity with the laws of mechanics.

In fact, it being admitted that they would describe an orbit round the moon, that orbit must necessarily be elliptical. Science proves that it must be thus. No movement round any body is an exception to that law. All the orbits described in space are elliptical, those of satellites round their planets, those of planets around their sun, that of the sun round the unknown orb that serves as its central pivot. Why should the projectile of the Gun Club escape that natural arrangement?

Now in elliptical orbits attracting bodies always occupy one of the foci of the ellipse. The satellite is, therefore, nearer the body round which it gravitates at one moment than it is at another. When the earth is nearest the sun she is at her perihelion, and at her aphelion when most distant. The moon is nearest the earth at her perigee, and most distant at her apogee. Now, if the projectile remained a satellite of the moon, it ought to be said that it is in its "aposelene" at its most distant point, and at its "periselene" at its nearest.

In the latter case the projectile ought to attain its maximum of speed, in the latter its minimum. Now it was evidently going towards its "aposelene," and Barbicané was right in thinking its speed would decrease up to that point,



and gradually increase when it would again draw near the moon. That speed even would be absolutely *nil* if the point was coexistent with that of attraction.

Barbicané studied the consequences of these different situations; he was trying what he could make of them when he was suddenly interrupted by a cry from Michel Ardan.

"I' faith!" cried Michel, "what fools we are!"

"I don't say we are not," answered Barbicané; "but why?"

"Because we have some very simple means of slackening the speed that is taking us away from the moon, and we do not use them."

"And what are those means?"

"That of utilizing the force of recoil in our rockets."

"Ah, why not?" said Nicholl.

"We have not yet utilized that force, it is true," said Barbicané, "but we shall do so."

"When?" asked Michel.

"When the time comes. Remark, my friends, that in the position now occupied by the projectile, a position still oblique to the lunar disc, our rockets, by altering its direction, might take it farther away instead of nearer to the moon. Now I suppose it is the moon you want to reach?"

"Essentially," answered Michel.

"Wait, then. Through some inexplicable influence the projectile has a tendency to let its lower end fall towards the earth. It is probable that at the point of equal attraction its conical end will be rigorously directed towards the moon. At that moment it may be hoped that its speed will be *nil*. That will be the time to act, and under the effort of our rockets we can, perhaps, provoke a direct fall upon the surface of the lunar disc."

"Bravo!" said Michel.

"We have not done it yet, and we could not do it as we passed the neutral point, because the projectile had too much speed."

"Well reasoned out," said Nicholl.

"We must wait patiently," said Barbicane, "and put every chance on our side; then, after having despaired so long, I again begin to think we shall reach our goal."

This conclusion provoked hurrahs from Michel Ardan. Not one of these daring madmen remembered the question they had all answered in the negative—No, the moon is not inhabited! No, the moon is probably not habitable! And yet they were going to do all they could to reach it.

One question only now remained to be solved: at what precise moment would the projectile reach that point of equal attraction where the travellers would play their last card?

In order to calculate that moment to within some seconds Barbicane had only to have recourse to his travelling notes, and to take the different altitudes from lunar parallels. Thus the time employed in going over the distance between the neutral point and the South Pole must be equal to the distance which separates the South Pole from the neutral point. The hours representing the time it took were carefully noted down, and the calculation became easy.

Barbicane found that this point would be reached by the projectile at 1 a.m. on the 8th of December. It was then 3 a.m. on the 7th of December. Therefore, if nothing intervened, the projectile would reach the neutral point in twenty-two hours.

The rockets had been put in their places to slacken the fall of the projectile upon the moon, and now the bold fellows were going to use them to provoke an exactly contrary effect. However that may be, they were ready, and there was nothing to do but await the moment for setting fire to them.

"As there is nothing to do," said Nicholl, "I have a proposition to make."

"What is that?" asked Barbicane.

"I propose we go to sleep."

"That is a nice idea!" exclaimed Michel Ardan.

"It is forty hours since we have closed our eyes," said Nicholl. "A few hours' sleep would set us up again."

"Never!" replied Michel.

"Good," said Nicholl; "every man to his humour—mine is to sleep."

And lying down on a divan, Nicholl was soon snoring.

"Nicholl is a sensible man," said Barbicane soon. "I shall imitate him."

A few minutes after he was joining his bass to the captain's baritone.

"Decidedly," said Michel Ardan, when he found himself alone, "these practical people sometimes do have odd ideas."

And stretching out his long legs, and folding his long arms under his head, Michel went to sleep too.

But this slumber could neither be durable nor peaceful. Too many preoccupations filled the minds of these three men, and a few hours after, at about 7 a.m., they all three awoke at once.

The projectile was still moving away from the moon, inclining its conical end more and more towards her. This phenomenon was inexplicable at present, but it fortunately aided the designs of Barbicane.

Another seventeen hours and the time for action would have come.

That day seemed long. However bold they might be, the travellers felt much anxiety at the approach of the minute that was to decide everything, either their fall upon the moon or their imprisonment in an everlasting orbit. They therefore counted the hours, which went too slowly for them, Barbicane and Nicholl obstinately plunged in calculations, Michel walking up and down the narrow space between the walls contemplating with longing eye the impassive moon.

Sometimes thoughts of the earth passed through their minds. They saw again their friends of the Gun Club, and the dearest of them all, J. T. Maston. At that moment the honourable secretary must have been at his post on the



Rocky Mountains. If he should perceive the projectile upon the mirror of his gigantic telescope what would he think? After having seen it disappear behind the south pole of the moon, they would see it reappear at the north! It was, therefore, the satellite of a satellite! Had J. T. Maston sent that unexpected announcement into the world? Was this to be the end of the great enterprise?

Meanwhile the day passed without incident. Terrestrial midnight came. The 8th of December was about to commence. Another hour and the point of equal attraction would be reached. What velocity then animated the projectile? They could form no estimate; but no error could vitiate Barbicane's calculations. At 1 a.m. that velocity ought to be and would be zero.

Besides, another phenomenon would mark the stopping point of the projectile on the neutral line. In that spot the two attractions, terrestrial and lunar, would be annihilated. Objects would not weigh anything. This singular fact, which had so curiously surprised Barbicane and his companions before, must again come about under identical circumstances. It was at that precise moment they must act.

The conical end of the projectile had already sensibly turned towards the lunar disc. The projectile was just right for utilizing all the recoil produced by setting fire to the apparatus. Chance was therefore in the travellers' favour. If the velocity of the projectile were to be absolutely annihilated upon the neutral point, a given motion, however slight, towards the moon would determine its fall.

"Five minutes to one," said Nicholl.

"Everything is ready," answered Michel Ardan, directing his match towards the flame of the gas.

"Wait!" said Barbicane, chronometer in hand.

At that moment weight had no effect. The travellers felt its complete disappearance in themselves. They were near the neutral point if they had not reached it.

"One o'clock!" said Barbicane.

Michel Ardan put his match to a contrivance that put



all the fuses into instantaneous communication. No detonation was heard outside, where air was wanting, but through the port-lights Barbicane saw the prolonged flame, which was immediately extinguished.

The projectile had a slight shock which was very sensibly felt in the interior.

The three friends looked, listened, without speaking, hardly breathing. The beating of their hearts might have been heard in the absolute silence.

"Are we falling?" asked Michel Ardan at last.

"No," answered Nicholl; "for the bottom of the projectile has not turned towards the lunar disc!"

At that moment Barbicane left his window and turned towards his two companions. He was frightfully pale, his forehead wrinkled, his lips contracted.

"We are falling!" said he.

"Ah!" cried Michel Ardan, "upon the moon?"

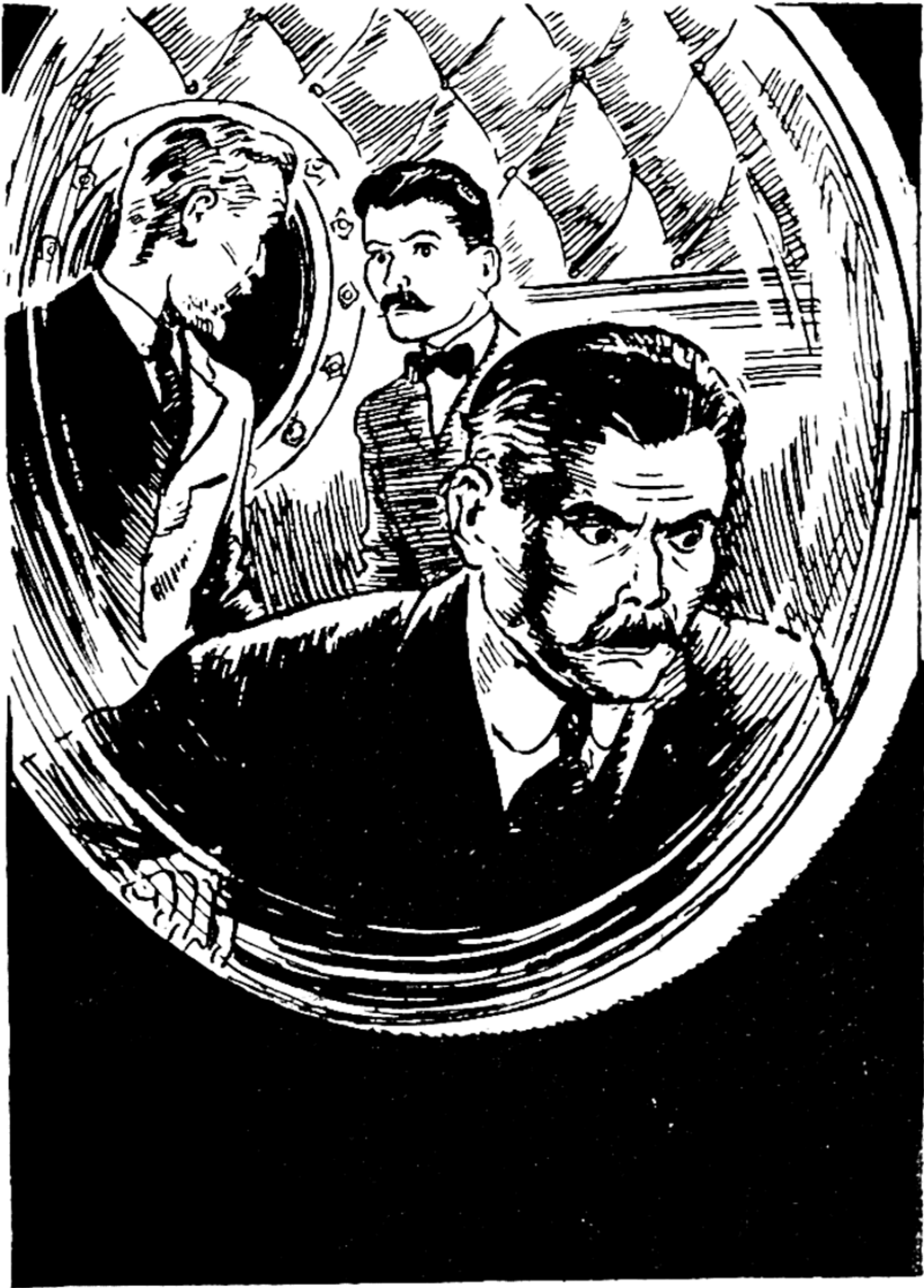
"Upon the earth!" answered Barbicane.

"The devil!" cried Michel Ardan; and he added philosophically, "when we started we did not think it would be so difficult to get out of it again."

In fact, the frightful fall had begun. The velocity kept by the projectile had sent it beyond the neutral point. The explosion of the fuses had not stopped it. That velocity which had carried the projectile beyond the neutral line as it went was destined to do the same upon its return. The law of physics condemned it, in its elliptical orbit, *to pass by every point it had already passed.*

It was a terrible fall from a height of 78,000 leagues, and which no springs could deaden. According to the laws of ballistics the projectile would strike the earth with a velocity equal to that which animated it as it left the Columbiad—a velocity of "16,000 metres in the last second!"

And in order to give some figures for comparison it has been calculated that an object thrown from the towers of Notre Dame, the altitude of which is only 200 feet, would reach the pavement with a velocity of 120 leagues an hour.



Barbicane watches through the port-light

Here the projectile would strike the earth with a velocity of 57,600 *leagues an hour*.

"We are lost men," said Nicholl coldly.

"Well, if we die," answered Barbicane, with a sort of religious enthusiasm, "the result of our journey will be magnificently enlarged! God will tell us His own secret! In the other life the soul will need neither machines nor engines in order to know! It will be identified with eternal wisdom!"

"True," replied Michel Ardan: "the other world may well console us for that trifling orb called the moon!"

Barbicane crossed his arms upon his chest with a movement of sublime resignation.

"God's will be done!" he said.

## CHAPTER XX

### THE SOUNDINGS OF THE "SUSQUEHANNA"

"WELL, lieutenant, and what about those soundings?"

"I think the operation is almost over, sir. But who would have expected to find such a depth so near land, at 100 leagues only from the American coast?"

"Yes, Bronsfield, there is a great depression," said Captain Blomsberry. "There exists a submarine valley here, hollowed out by Humboldt's current, which runs along the coasts of America to the Straits of Magellan."

"Those great depths," said the lieutenant, "are not favourable for the laying of telegraph cables. A smooth plateau is the best, like the one the American cable lies on between Valentia and Newfoundland."

"I agree with you, Bronsfield. And, may it please you, lieutenant, where are we now?"

"Sir," answered Bronsfield, "we have at this moment 21,500 feet of line out, and the bullet at the end of the line has not yet touched the bottom, for the sounding-lead would have come up again."

"Brook's apparatus is an ingenious one," said Captain Blomsberry. "It allows us to obtain very correct soundings."

"Touched!" cried at that moment one of the forecastlemen who was superintending the operation.

The captain and lieutenant went on to the forecastle-deck.

"What depth are we in?" asked the captain.

"Twenty-one thousand seven hundred and sixty-two feet," answered the lieutenant, writing it down in his pocket-book.

"Very well, Bronsfield," said the captain, "I will go and mark the result on my chart. Now have the sounding-line



brought in—that is a work of several hours. Meanwhile the engineer shall have his fires lighted, and we shall be ready to start as soon as you have done. It is 10 p.m., and with your permission, lieutenant, I shall turn in.”

“Certainly, sir, certainly!” answered Lieutenant Bronsfield amiably.

The captain of the *Susquehanna*, a worthy man if ever there was one, the very humble servant of his officers, went to his cabin, took his brandy-and-water with many expressions of satisfaction to the steward, got into bed, not before complimenting his servant on the way he made beds, and sank into peaceful slumber.

It was then 10 p.m. The eleventh day of the month of December was going to end in a magnificent night.

The *Susquehanna*, a corvette of 500 horse-power, of the United States Navy, was taking soundings in the Pacific at about a hundred leagues from the American coast, abreast of that long peninsula on the coast of New Mexico.

The wind had gradually fallen. There was not the slightest movement in the air. The colours of the corvette hung from the mast motionless and inert.

The captain, Jonathan Blomsberry, cousin-german to Colonel Blomsberry, one of the Gun Club members who had married a Horschbidden, the captain's aunt and daughter of an honourable Kentucky merchant—Captain Blomsberry could not have wished for better weather to carry out the delicate operation of sounding. His corvette had felt nothing of that great tempest which swept away the clouds heaped up on the Rocky Mountains, and allowed the course of the famous projectile to be observed. All was going on well, and he did not forget to thank Heaven.

The series of soundings executed by the *Susquehanna* were intended for finding out the most favourable bottoms for the laying of a submarine cable between the Hawaian Islands and the American coast.

It was a vast project set on foot by a powerful company. Its director, the intelligent Cyrus Field, meant even to cover

all the Islands of Oceania with a vast electric network—an immense enterprise worthy of American genius.

It was to the corvette *Susquehanna* that the first operations of sounding had been entrusted. During the night from the 11th to the 12th of December she was exactly in north lat.  $27^{\circ} 7'$  and  $41^{\circ} 37'$  long., west from the Washington meridian.

The moon, then in her last quarter, began to show herself above the horizon.

After Captain Blomsberry's departure, Lieutenant Bronsfield and a few officers were together on the poop. As the moon appeared their thoughts turned towards that orb which the eyes of a whole hemisphere were then contemplating. The best marine glasses could not have discovered the projectile wandering round the moon, and yet they were all pointed at the shining disc which millions of eyes were looking at in the same moment.

"They started ten days ago," then said Lieutenant Bronsfield. "What can have become of them?"

"They have arrived, sir," exclaimed a young midshipman, "and they are doing what all travellers do in a new country, they are looking about them."

"I am certain of it as you say so, my young friend," answered Lieutenant Bronsfield, smiling.

"Still," said another officer, "their arrival cannot be doubted. The projectile must have reached the moon at the moment she was full, at midnight on the 5th. We are now at the 11th of December; that makes six days. Now in six times twenty-four hours, with no darkness, they have had time to get comfortably settled. It seems to me that I see our brave countrymen encamped at the bottom of a valley, on the borders of a Selenite stream, near the projectile, half buried by its fall, amidst volcanic remains, Captain Nicholl beginning his levelling operations, President Barbicane putting his travelling notes in order, Michel Ardan perfuming the lunar solitudes with his Londrès cigar——"

"Oh, it must be so; it is so!" exclaimed the young

midshipman, enthusiastic at the ideal description of his superior.

"I should like to believe it," answered Lieutenant Bronsfield, who was seldom carried away. "Unfortunately direct news from the lunar world will always be wanting."

"Excuse me, sir," said the midshipman, "but cannot President Barbicane write?"

A roar of laughter greeted this answer.

"Not letters," answered the young man quickly. "The post office has nothing to do with that."

"Perhaps you mean the telegraph office?" said one of the officers ironically.

"Nor that either," answered the midshipman, who would not give in. "But it is very easy to establish graphic communication with the earth."

"And how, pray?"

"By means of the telescope on Long's Peak. You know that it brings the moon to within two leagues only of the Rocky Mountains, and that it allows them to see objects having nine feet of diameter on her surface. Well, our industrious friends will construct a gigantic alphabet! They will write words 600 feet long, and sentences a league long, and then they can send us news!"

The young midshipman, who certainly had some imagination, was loudly applauded. Lieutenant Bronsfield himself was convinced that the idea could have been carried out. He added that by sending luminous rays, grouped by means of parabolical mirrors, direct communications could also be established—in fact, these rays would be as visible on the surface of Venus or Mars as the planet Neptune is from the earth. He ended by saying that the brilliant points already observed on the nearest planets might be signals made to the earth. But he said, that though by these means they could have news from the lunar world, they could not send any from the terrestrial world unless the Selenites have at their disposition instruments with which to make distant observations.



"That is evident," answered one of the officers, "but what has become of the travellers? What have they done? What have they seen? That is what interests us. Besides, if the experiment has succeeded, which I do not doubt, it will be done again. The Columbiad is still walled up in the soil of Florida. It is, therefore, now only a question of powder and shot, and every time the moon passes the zenith we can send it a cargo of visitors."

"It is evident," answered Lieutenant Bronsfield, "that J. T. Maston will go and join his friends one of these days."

"If he will have me," exclaimed the midshipman, "I am ready to go with him."

"Oh, there will be plenty of amateurs, and if they are allowed to go, half the inhabitants of the earth will soon have emigrated to the moon!"

This conversation between the officers of the *Susquehanna* was kept up till about 1 a.m. It would be impossible to describe the many and audacious theories put forward. Since Barbicane's attempt it seemed that nothing was impossible to Americans. They had already formed the project of sending, not another commission of experts, but a whole colony, and a whole army of infantry, artillery, and cavalry to conquer the lunar world.

At 1 a.m. the sounding-line was not all hauled in. Ten thousand feet remained out, which would take several more hours to bring in. According to the commander's orders the fires had been lighted, and the pressure was going up already. The *Susquehanna* might have started at once.

At that very moment—it was 1.17 a.m.—Lieutenant Bronsfield was about to leave his watch to turn in when his attention was attracted by a distant and quite unexpected hissing sound.

His comrades and he at first thought that the hissing came from an escape of steam, but upon lifting up his head he found that it was high up in the air.

They had not time to question each other before the hissing became of frightful intensity, and suddenly to their



dazzled eyes appeared an enormous body, glowing by its friction against the atmosphere.

This ignited mass grew huger as it came nearer, and fell with the noise of thunder upon the bowsprit of the corvette, which it smashed off close to the stem, and vanished in the waves.

A few feet nearer and the *Susquehanna* would have gone down with all on board.

At that moment Captain Blomsberry appeared half-clothed, and rushing in the forecastle, where his officers had preceded him—

“With your permission, gentlemen, what has happened?” he asked.

And the midshipman, making himself the mouthpiece of them all, cried out—

“Commander, it is ‘they’ come back again.”

## CHAPTER XXI

J. T. MASTON CALLED IN

EMOTION was great on board the *Susquehanna*. Officers and sailors forgot the terrible danger they had just been in—the danger of being crushed and sunk. They only thought of the catastrophe which terminated the journey. Thus, therefore, the most audacious enterprise of ancient and modern times lost the life of the bold adventurers who had attempted it.

“It is ‘they’ come back,” the young midshipman had said, and they had all understood. No one doubted that the glowing body was the projectile of the Gun Club. Opinions were divided about the fate of the travellers.

“They are dead!” said one.

“They are alive,” answered the other. “The water is deep here, and the shock has been deadened.”

“But they will have no air, and will be suffocated!”

“Burnt!” answered the other. “Their projectile was only an incandescent mass as it crossed the atmosphere.”

“What does it matter?” was answered unanimously, “living or dead they must be brought up from there.”

Meanwhile Captain Blomsberry had called his officers together, and with their permission he held a council. Something must be done immediately. The most immediate was to haul up the projectile—a difficult operation, but not an impossible one. But the corvette wanted the necessary engines, which would have to be powerful and precise. It was, therefore, resolved to put into the nearest port, and to send word to the Gun Club.

This determination was taken unanimously. The choice of a port was discussed. The neighbouring coast had no harbour on the 27th degree of latitude. Higher up, above the peninsula of Monterey, was the important town which has

given its name to it. But, seated on the edge of a veritable desert, it had no telegraphic communication with the interior, and electricity alone could spread the important news quickly enough.

Some degrees above lay the bay of San Francisco. Through the capital of the Gold Country communication with the centre of the Union would be easy. By putting all steam on, the *Susquehanna*, in less than two days, could reach the port of San Francisco. She must, therefore, start at once.

The fires were heaped up, and they could set sail immediately. Two thousand fathoms of sounding still remained in the water. Captain Blomsberry would not lose precious time in hauling it in, and resolved to cut the line.

"We will fix the end to a buoy," said he, "and the buoy will indicate the exact point where the projectile fell."

"Besides," answered Lieutenant Bronsfield, "we have our exact bearings: north lat.  $27^{\circ} 7'$ , and west long.  $41^{\circ} 37'$ ."

"Very well, Mr. Bronsfield," answered the captain; "with your permission, have the line cut."

A strong buoy, reinforced by a couple of spars, was thrown out on to the surface of the ocean. The end of the line was solidly struck beneath, and only submitted to the ebb and flow of the surges, so that it would not drift much.

At that moment the engineer came to warn the captain that he had put the pressure on, and they could start. The captain thanked him for his excellent communication. Then he gave N.N.E. as the route. The corvette was put about and made for the bay of San Francisco with all steam on. It was then 3 a.m.

Two hundred leagues to get over was not much for a fast vessel like the *Susquehanna*. It got over that distance in thirty-six hours, and on the 14th of December, at 1.27 p.m., she would enter the bay of San Francisco.

At the sight of this vessel of the national navy arriving with all speed on, her bowsprit gone, and her mainmast propped up, public curiosity was very excited. A compact crowd was soon assembled on the quays awaiting the landing.

After weighing anchor Captain Blomsberry and Lieutenant Bronsfield got down into an eight-oared boat which carried them rapidly to the land.

They jumped out on the quay.

"The telegraph office?" they asked, without answering one of the thousand questions that were showered upon them.

The port inspector guided them himself to the telegraph office, amidst an immense crowd of curious people.

Blomsberry and Bronsfield went into the office whilst the crowd crushed against the door.

A few minutes later one message was sent in four different directions:—1st, to the Secretary of the Navy, Washington; 2nd, to the Vice-President of the Gun Club, Baltimore; 3rd, to the Honourable J. T. Maston, Long's Peak, Rocky Mountains; 4th to the Sub-Director of the Cambridge Observatory, Massachusetts.

It ran as follows:—

"In north lat.  $20^{\circ} 7'$ , and west long.  $41^{\circ} 37'$ , the projectile of the Columbiad fell into the Pacific, on December 12th, at 1.17 a.m. Send instructions.—BLOMSBERRY, Commander *Susquehanna*."

Five minutes afterwards the whole town of San Francisco knew the news. Before 6 p.m. the different States of the Union had reports of the great catastrophe. After midnight, through the cable, the whole of Europe knew the result of the great American enterprise.

It would be impossible to describe the effect produced throughout the world by the unexpected news.

On receipt of the telegram the Secretary of the Navy telegraphed to the *Susquehanna* to keep under fire, and wait in the bay of San Francisco. She was to be ready to set sail day or night.

The Observatory of Cambridge had an extraordinary meeting, and, with the serenity which distinguishes scien-



tific bodies, it calmly discussed the scientific part of the question.

At the Gun Club there was an explosion. All the artillerymen were assembled. The Vice-President, the Honourable Wilcome, was just reading the premature telegram by which Messrs. Maston and Belfast announced that the projectile had just been perceived in the gigantic reflector of Long's Peak. This communication informed them also that the projectile, retained by the attraction of the moon, was playing the part of sub-satellite in the solar world.

The truth on this subject is now known.

However, upon the arrival of Blomsberry's message, which so formally contradicted J. T. Maston's telegram, two parties were formed in the bosom of the Gun Club. On the one side were members who admitted the fall of the projectile, and consequently the return of the travellers. On the other were those who, holding by the observations at Long's Peak, concluded that the Commander of the *Susquehanna* was mistaken. According to the latter, the pretended projectile was only a shooting star, which in its fall had damaged the corvette. Their argument could not very well be answered, because the velocity with which it was endowed had made its observation very difficult. The commander of the *Susquehanna* and his officers might certainly have been mistaken in good faith. One argument certainly was in their favour: if the projectile had fallen on the earth it must have touched the terrestrial spheroid upon the 27th degree of north latitude, and, taking into account the time that had elapsed, and the earth's movement of rotation, between the 41st and 42nd degree of west longitude.

However that might be, it was unanimously decided in the Gun Club that Blomsberry's brother Bilsby and Major Elphinstone should start at once for San Francisco and give their advice about the means of dragging up the projectile from the depths of the ocean.

These men started without losing an instant, and the

railway which was soon to cross the whole of Central America took them to St. Louis, where rapid mail-coaches awaited them.

Almost at the same moment that the Secretary of the Navy, the Vice-President of the Gun Club, and the Sub-Director of the Observatory received the telegram from San Francisco, the Honourable J. T. Maston felt the most violent emotion of his whole existence—an emotion not even equalled by that he had experienced when his celebrated cannon was blown up, and which, like it, nearly cost him his life.

It will be remembered that the Secretary of the Gun Club had started some minutes after the projectile—and almost as quickly—for the station of Long's Peak in the Rocky Mountains. The learned J. Belfast, Director of the Cambridge Observatory, accompanied him. Arrived at the station the two friends had summarily installed themselves, and no longer left the summit of their enormous telescope.

We know that this gigantic instrument had been set up on the reflecting system, called "front view" by the English. This arrangement only gave one reflection of objects, and consequently made the view much clearer. The result was that J. T. Maston and Belfast, whilst observing, were stationed in the upper part of the instrument instead of in the lower. They reached it by a twisted staircase, a masterpiece of lightness, and below them lay the metal, well terminated by the metallic mirror, 280 feet deep.

Now it was upon the narrow platform placed round the telescope that the two scientists passed their existence, cursing the daylight which hid the moon from their eyes, and the clouds which obstinately veiled her at night.

Who can depict their delight when, after waiting several days, during the night of December 5th they perceived the vehicle that was carrying their friends through space? To that delight succeeded deep disappointment when, trusting to incomplete observations, they sent out with their first telegram to the world the erroneous information that the

projectile had become a satellite of the moon gravitating in an endless orbit.

After that instant the projectile disappeared behind the invisible disc of the moon. But when it ought to have reappeared on the invisible disc the impatience of J. T. Maston and his no less impatient companion may be imagined. At every minute of the night they thought they should see the projectile again, and they did not see it. Hence between them arose endless discussions and violent disputes, Belfast affirming that the projectile was not visible, J. T. Maston affirming that anyone but a blind man could see it.

"It is the projectile!" repeated J. T. Maston.

"No!" answered Belfast, "it is an avalanche falling from a lunar mountain!"

"Well, then, we shall see it to-morrow."

"No, it will be seen no more. It is carried away into space."

"We shall see it, I tell you."

"No, we shall not."

And while these interjections were being showered like hail, the well-known irritability of the Secretary of the Gun Club constituted a permanent danger to the director, Belfast.

Their existence together would soon have become impossible, but an unexpected event cut short these eternal discussions.

During the night between the 12th and 13th of December the two irreconcilable friends were occupied in observing the lunar disc. J. T. Maston was, as usual, saying strong things to the learned Belfast, who was getting angry too. The Secretary of the Gun Club declared for the thousandth time that he had just perceived the projectile, adding even that Michel Ardan's face had appeared at one of the port-lights. He was emphasizing his arguments by a series of gestures which his redoubtable hook rendered dangerous.

At that moment Belfast's servant appeared upon the platform—it was 10 p.m.—and gave him a telegram. It was the message from the Commander of the *Susquehanna*.



Belfast tore the envelope, read the enclosure, and uttered a cry.

"What is it?" said J. T. Maston.

"It's the projectile!"

"What of that?"

"It has fallen upon the earth!"

Another cry; this time a howl answered him.

He turned towards J. T. Maston. The unfortunate fellow, leaning imprudently over the metal tube, had disappeared down the immense telescope—a fall of 280 feet! Belfast, distracted, rushed towards the orifice of the reflector.

He breathed again. J. T. Maston's steel hook had caught in one of the props which maintained the platform of the telescope. He was uttering formidable cries.

Belfast called. Help came, and the imprudent secretary was hoisted up, not without trouble.

He reappeared unhurt at the upper orifice.

"Suppose I had broken the mirror?" said he.

"You would have paid for it," answered Belfast severely.

"And where has the infernal craft fallen?" asked J. T. Maston.

"Into the Pacific."

"Let us start at once."

A quarter of an hour afterwards the two learned friends were descending the slope of the Rocky Mountains, and two days afterwards they reached San Francisco at the same time as their friends of the Gun Club, having killed five horses on the road.

Elphinstone, Blomsberry, and Bilsby rushed up to them upon their arrival.

"What is to be done?" they exclaimed.

"The projectile must be fished up," answered J. T. Maston, "and as soon as possible!"



## CHAPTER XXII

### PICKED UP

THE very spot where the projectile had disappeared under the waves was exactly known. The instruments for seizing it and bringing it to the surface of the ocean were still wanting. They had to be invented and then manufactured. American engineers could not be embarrassed by such a trifle. The grappling-irons once established and steam helping, they were assured of raising the projectile, notwithstanding its weight.

But it was not enough to fish up the projectile. It was necessary to act promptly in the interest of the travellers. No one doubted that they were still living.

"Yes," repeated J. T. Maston incessantly, whose confidence inspired everybody, "our friends are clever fellows, and they cannot have fallen like imbeciles. They are alive, alive and well, but we must make haste in order to find them so. He had no anxiety about provisions and water. They had enough for a long time! But air!—air would soon fail them. Then they must make haste!"

And they did make haste. They prepared the *Susquehanna* for her destination. Her powerful engines were arranged to be used for the hauling machines. The aluminium projectile only weighed 19,250 lbs., a much less weight than that of the transatlantic cable, which was picked up under similar circumstances. The only difficulty lay in the smooth sides of the cylindro-conical body, which made it difficult to grapple.

With that end in view the engineer Murchison, summoned to San Francisco, caused enormous grappling-irons to be fitted upon an automatic system which would not let the projectile go again if they succeeded in seizing it with their

powerful pincers. He also had some diving-dresses prepared, which, by their impermeable and resisting texture, allowed divers to survey the bottom of the sea. He likewise embarked on board the *Susquehanna* apparatus for compressed air, very ingeniously contrived. They were veritable rooms, with port-lights in them, and which by introducing the water into certain compartments, could be sunk to great depths. The apparatus was already at San Francisco, where it had been used in the construction of a submarine dyke. This was fortunate, for there would not have been time to make one.

Yet notwithstanding the perfection of the apparatus, notwithstanding the ingenuity of the experts who were to use them, the success of the operation was anything but assured. Fishing up a large body from 20,000 feet under water must be an uncertain operation. And even if it were brought to the surface, how had the travellers borne the terrible shock that even 20,000 feet of water would not sufficiently deaden?

In short, everything must be done quickly. J. T. Maston hurried on his workmen day and night. He was ready either to buckle on the diver's dress or try the air-apparatus in order to find his courageous friends.

Still, notwithstanding the diligence with which the different machines were got ready, notwithstanding the considerable sums which were placed at the disposition of the Gun Club by the Government of the Union, five long days (five centuries) went by before the preparations were completed. During that time public opinion was excited to the highest point. Telegrams were incessantly exchanged all over the world through the electric wires and cables. The saving of Barbicane, Nicholl, and Michel Ardan became an international business. All the nations that had subscribed to the enterprise of the Gun Club were equally interested in the safety of the travellers.

At last the grappling-chains, air-chambers, and automatic grappling-irons were embarked on board the *Susquehanna*. J. T. Maston, the engineer Murchison, and the Gun Club

delegates already occupied their cabins. There was nothing to do but to start.

On the 21st of December, at 8 p.m., the corvette set sail on a calm sea with a rather cold north-east wind blowing. All the population of San Francisco crowded on to the quays, mute and anxious, reserving its hurrahs for the return.

The steam was put on to its maximum of pressure, and the screw of the *Susquehanna* carried it rapidly out of the bay.

It would be useless to relate the conversations on board amongst the officers, sailors, and passengers. All these men had but one thought. Their hearts all beat with the same emotion. What were Barbicane and his companions doing whilst they were hastening to their rescue? What had become of them? Had they been able to attempt some audacious manœuvre to recover their liberty? No one could say. The truth is that any attempt would have failed. Sunk to nearly two leagues under the ocean, their metal prison would defy any effort of its prisoners.

On the 23rd of December, at 8 a.m., after a rapid passage, the *Susquehanna* ought to be on the scene of the diasaster. They were obliged to wait till twelve o'clock to take their exact bearings. The buoy fastened on to the sounding-line had not yet been seen.

At noon Captain Blomsberry, helped by his officers, who controlled the observation, made his point in the presence of the delegates of the Gun Club. That was an anxious moment. The *Susquehanna* was found to be at some minutes west of the very spot where the projectile had disappeared under the waves.

The direction of the corvette was, therefore, given in view of reaching the precise spot.

At 12.47 p.m. the buoy was sighted. It was in perfect order, and did not seem to have drifted far.

"At last!" exclaimed J. T. Maston.

"Shall we begin?" asked Captain Blomsberry.



"Without losing a second," answered J. T. Maston.

Every precaution was taken to keep the corvette perfectly motionless.

Before trying to grapple the projectile, the engineer, Murchison, wished to find out its exact position on the sea-bottom. The submarine apparatus for this search received their provision of air. The handling of these engines is not without danger, for at 20,000 feet below the surface of the water and under such great pressure they are exposed to ruptures the consequences of which could be terrible.

J. T. Maston, the commander's brother, and the engineer Murchison, without a thought of these dangers, took their places in the air-chambers. The Commander, on his foot-bridge, presided over the operation, ready to stop or haul in his chains at the least signal. The screw had been taken off, and all the force of the machines upon the windlass would soon have brought up the apparatus on board.

The descent began at 1.25 p.m., and the chamber, dragged down by its reservoirs filled with water, disappeared under the surface of the ocean.

The emotion of the officers and sailors on board was now divided between the prisoners in the projectile and the prisoners of the submarine apparatus. These latter forgot themselves, and, glued to the panes of the port-lights, they attentively observed the liquid masses they were passing through.

The descent was rapid. At 2.17 p.m. J. T. Maston and his companions had reached the bottom of the Pacific; but they saw nothing except the lifeless sea-bed. By the light of their lamps, furnished with powerful reflectors, they could observe the dark layers of water in a rather large radius, but the projectile remained invisible in their eyes.

The impatience of these bold divers could hardly be described. Their apparatus being in electric communication with the corvette, they made a signal agreed upon, and the *Susquehanna* carried their chamber over a mile of space at one yard from the soil.



They thus explored all the submarine plain, deceived at every instant by optical delusions which cut them to the heart. Here a rock, there a swelling of the ground, looked to them like the much-sought-for projectile; then they would soon find out their error and despair again.

"Where are they? Where can they be?" cried J. T. Maston.

And the poor man called aloud to Nicholl, Barbicane, and Michel Ardan, as if his unfortunate friends could have heard him through that impenetrable medium!

The search went on under those conditions until the state of the air in the apparatus forced the divers to go up again.

The hauling in was begun at 6 p.m., and was not terminated before midnight.

"We will try again to-morrow," said J. T. Maston as he stepped on to the deck of the corvette.

"Yes," answered Captain Blomsberry.

"And in another place."

"Yes."

J. T. Maston did not yet doubt his ultimate success, but his companions, who were no longer intoxicated with the animation of the first few hours, already took in all the difficulties of the enterprise. What seemed easy at San Francisco in open ocean appeared almost impossible. The chances of success diminished in a large proportion, and it was to chance alone that the finding of the projectile had to be left.

The next day, the 24th of December, notwithstanding the fatigues of the preceding day, operations were resumed. The corvette moved some minutes farther west, and the apparatus, provisioned with air again, took the same explorers to the depths of the ocean.

All that day was passed in a fruitless search. The bed of the sea was a desert. The day of the 25th brought no result, neither did that of the 26th.

It was disheartening. They thought of the unfortunate

men shut up for twenty-six days in the projectile. Perhaps they were all feeling the first symptoms of suffocation, even if they had escaped the dangers of their fall. The air was getting exhausted, and doubtless with the air their courage and spirits.

On the 28th, after two days' search, all hope was lost. This body was an atom in the immensity of the sea! They must give up the hope of finding it.

Still J. T. Maston would not hear about leaving. He would not abandon the place without having at least found the tomb of his friends. But Captain Blomsberry could not stay on indefinitely, and notwithstanding the opposition of the worthy secretary, he was obliged to give orders to set sail.

On the 29th of December, at 9 a.m., the *Susquehanna*, heading north-east, began to return to the bay of San Francisco.

It was 10 a.m. The corvette was leaving slowly and as if with regret the scene of the catastrophe, when the sailor at the mast-head, who was on the look-out, called out all at once—

“A buoy on the lee bow!”

The officers looked in the direction indicated. They saw through their telescopes the object signalled, which did look like one of those buoys used for marking the openings of bays or rivers; but, unlike them, a flag floating in the wind surmounted a cone which emerged five or six feet. This buoy shone in the sunshine as if made of plates of silver.

The Commander, Blomsberry, J. T. Maston, and the delegates of the Gun Club ascended the foot-bridge and examined the object thus drifting on the waves.

All looked with feverish anxiety, but in silence. None of them dared utter the thought that came into all their minds.

The corvette approached to within two cables' length of the object.

A shudder ran through the whole crew.

The flag was an American one!

At that moment a veritable roar was heard. It was the worthy J. T. Maston, who had fallen in a heap; forgetting on the one hand that he had only an iron hook for one arm, and on the other that a simple guttapercha cap covered his head, he had given himself a formidable blow.

They rushed towards him and picked him up. They recalled him to life. And what were his first words?

"Ah! triple brutes! quadruple idiots! quintuple boobies that we are!"

"What is the matter?" everyone round him exclaimed.

"Speak, can't you?"

"It is, imbeciles," shouted the terrible secretary, "it is that the projectile only weighs 19,250 lbs!"

"Well?"

"And it displaces 28 tons, or 56,000 lbs., consequently *it floats!*"

Ah! how that worthy man did underline the verb "to float!" And it was the truth! All, yes! all these experts had forgotten this fundamental law, that in consequence of its specific lightness the projectile, after having been dragged by its fall to the greatest depths of the ocean, had naturally returned to the surface; and now it was floating tranquilly whichever way the wind cared to carry it.

The boats had been lowered. J. T. Maston and his friends rushed into them. The excitement was at its highest point. All hearts palpitated whilst the boats rowed towards the projectile. What did it contain—the living or the dead? The living. Yes! unless death had struck down Barbicane and his companions since they had hoisted the flag!

Profound silence reigned in the boats. All hearts stopped beating. Eyes no longer performed their office. One of the port-lights of the projectile was opened. Some pieces of glass remaining in the frame proved that it had been broken. This port-light was situated actually five feet above water.





"Double blank, Barbicane, double blank!"



A boat drew alongside—that of J. T. Maston. He rushed to the broken window.

At that moment the joyful and clear voice of Michel Ardan was heard exclaiming in the accents of victory—

“Double blank, Barbicane, double blank!”

Barbicane, Michel Ardan, and Nicholl were playing at dominoes.

## CHAPTER XXIII

### THE END

It will be remembered that immense interest accompanied the three travellers upon their departure. If the beginning of their enterprise had caused such excitement in the old and new world, what enthusiasm must welcome their return! Would not the millions of spectators who had invaded the Floridian peninsula rush to meet the sublime adventurers? Would those legions of foreigners from all points of the globe, now in America, leave the Union without seeing Barbicane, Nicholl, and Michel Ardan once more? No, and the ardent passion of the public would worthily respond to the grandeur of the enterprise. Human beings who had left the terrestrial spheroid, who had returned after their strange journey into celestial space, could not fail to be received like the prophet Elijah when he returned to the earth. To see them first, to hear them afterwards, was the general desire.

This desire was to be very promptly realized by almost all the inhabitants of the Union.

Barbicane, Michel Ardan, Nicholl, and the delegates of the Gun Club returned without delay to Baltimore, and were there received with indescribable enthusiasm. The president's travelling notes were ready to be given up for publicity. The *New York Herald* bought this manuscript at a price which is not yet known but which must have been enormous. In fact, during the publication of the *Journey to the Moon* they printed 5,000,000 copies of that newspaper. Three days after the travellers' return to the earth the least details of their expedition were known. The only thing remaining to be done was to see the heroes of this super-human enterprise.

The adventure of Barbicane and his friends around the moon had allowed them to control the different theories about the terrestrial satellite. These great people had observed it, and under quite peculiar circumstances. It was now known which systems were to be rejected, which admitted, upon the formation of this orb, its origin, and its inhabitability. Its past, present, and future had given up their secrets. What could be objected to conscientious observations made at less than forty miles from that curious mountain of Tycho, the strangest mountain system of lunar orography? What answers could be made to those who had looked into the dark depths of the amphitheatre of Pluto? Who could contradict these audacious men whom the hazards of their enterprise had carried over the invisible disc of the moon, which no human eye had ever seen before? It was now their prerogative to impose the limits of lunar science which had built up the lunar world like Cuvier did the skeleton of a fossil, and to say, "The moon was this, a world inhabitable and inhabited before the earth! The moon is this, a world now uninhabitable and uninhabited!"

In order to welcome the return of the most illustrious of its members and his two companions, the Gun Club thought of giving them a banquet; but a banquet worthy of them, worthy of the American people, and under such circumstances that all the inhabitants of the Union could take a direct part in it.

All the termini of the railroads in the State were joined together by movable rails. Then, in all the stations hung with the same flags, decorated with the same ornaments, were spread tables uniformly dressed. At a certain time, severely calculated upon electric clocks which beat the seconds at the same instant, the inhabitants were invited to take their places at the same banquet.

During four days, from the 5th to the 9th of January, the trains were suspended like they are on Sundays upon the railways of the Union, and all the lines were free.

One locomotive alone, a very fast engine, dragging a state

saloon, had the right of circulating, during these four days, upon the railways of the United States.

This locomotive, conducted by a stoker and a mechanic, carried, by a great favour, the Honourable J. T. Maston, Secretary of the Gun Club.

The saloon was reserved for President Barbicane, Captain Nicholl and Michel Ardan.

The train left the station of Baltimore amidst the hurrahs and all the admiring interjections of the American language. It went at the speed of eighty leagues an hour. But what was that speed compared to the one with which the three heroes had left the Columbiad?

Thus they went from one town to another, finding the population in crowds upon their passage saluting them with the same acclamations, and showering upon them the same "bravoes." They thus travelled over the east of the Union through Pennsylvania, Connecticut, Massachusetts, Vermont, Maine, and New Brunswick; north and west through New York, Ohio, Michigan, and Wisconsin; south through Illinois, Missouri, Arkansas, Texas, and Louisiana; south-east through Alabama and Florida, Georgia, and the Carolinas; they visited the centre through Tennessee, Kentucky, Virginia, and Indiana; then after the station of Washington they re-entered Baltimore, and during four days they could imagine that the United States of America, seated at one immense banquet, saluted them simultaneously with the same hurrahs.

This apotheosis was worthy of these heroes, whom fable would have placed in the ranks of demi-gods.

And now would this attempt, without precedent in the annals of travels, have any practical result? Would direct communication ever be established with the moon? Would a service of navigation ever be founded across space for the solar world? Will people ever go from planet to planet, from Jupiter to Mercury, and later on from one star to another, from the Polar star to Sirius, would a method of locomotion allow of visiting the suns which swarm in the firmament?

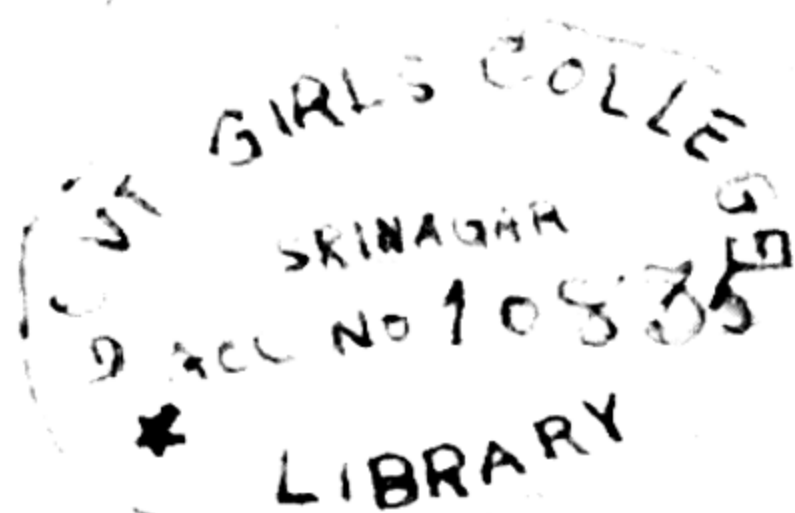


## ROUND THE MOON

No answer can be given to these questions, but knowing the audacious ingenuity of the Anglo-Saxon race, no one will be astonished that the Americans tried to turn President Barbicane's experiment to account.

Thus some time after the return of the travellers the public received with marked favour the advertisement of a Joint-Stock Company (Limited), with a capital of a hundred million dollars, divided into a hundred thousand shares of a thousand dollars each, under the name of *National Company for Interstellar Communication*—President, Barbicane; Vice-President, Captain Nicholl; Secretary J. T. Maston; Director, Michel Ardan.

THE END



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